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ANCIENT HISTORY

METAL NAMES AND THE INDO-EUROPEAN HOMELAND

Abstract: Indo-European studies established that the Proto-Indo-Europeans were familiar with copper. However, at a very early stage, they were also familiar with other metals: tin, lead, gold, and silver. Therefore, their homeland can only be located in a region where all these metals were produced in antiquity. This immediately eliminates the Eastern European steppes from the list of possible candidates. The analysis of distribution of metal names across different language groups, as well as their relations with the names in languages of the Caucasus and the Near East, allows two main dialectal areas to be identified: 1) Balto-Slavic in Transcaucasia. Adjacent to the latter was the Indo-Iranian area in the region of Lakes Van, Sevan, and Urmia. 2) Germanic-Celtic-Italic + Tocharian in the upper Euphrates region. The area of formations of Albanian and Armenian lay between area (2) and Indo-Iranian one, while Greek developed in northeastern Anatolia. These areas correspond to different ceramic styles of the Kura-Araxes culture. To the west, center, and west of Asia Minor lay the Anatolian language area. Migration of speakers of northwestern Indo-European languages to Europe occurred through Siberia and Eastern Europe, but some of them penetrated far east, as evidenced by borrowings of metal names into the Finno-Ugric and Chinese languages.

Key words: *Indo-European homeland, copper, tin, lead, gold, silver, Kura-Araxes culture.*

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INTRODUCTION

The Indo-European (IE) origin is a fundamental problem in both archaeology and linguistics. There are two main theories regarding the location of the IE homeland: the steppe zone of Eastern Europe in the Eneolithic period¹ and the Near East.² In recent years, I have published a series of papers that use archaeology, genetics, and linguistics to demonstrate the migrations of various IE groups from the Near East.³ The Proto-Indo-European (PIE) stage has been associated with the Neolithic and Early Bronze Age of the Near East.

This paper aims to determine the extent to which metallurgical terminology corresponds to the proposed migration pattern. Addressing this topic is practically mandatory when determining the IE homeland, as it is clear that copper was already known during the PIE stage. However, it is not the key to solving the problem, as the first copper appeared in Eastern Europe in the Eneolithic and in the Near East in the Neolithic. I have been studying

¹ MALLORY 1989; ANTHONY 2007.

² GAMKRELIDZE/IVANOV 1995; GRIGORIEV 2002.

³ GRIGORIEV 2022a; 2022b; 2023a; 2023b; 2025a; 2025b.

archaeometallurgy for many years, and have always been struck by the absolute rationality of this production, where any transformation was driven by raw materials, contacts, and the logic of technological development. This rationality should also be reflected in metallurgical terminology. However, to uncover it, we need to delve into details, not just note the presence of a name for a particular metal in a particular language or region. Looking ahead, I should say that all metal names clearly points to the location of the IE homeland in the Near East.

COPPER

IE languages have various names for copper, but the basic ones are two with the PIE stems **r(e)ud^h-* и **h₂aye/os-*. It is indicative that derivatives of these stems were also used in some languages to denote ore, bronze, and sometimes iron. The transition of these names to bronze and iron is understandable, since the original meaning could have been 'metal', and the transition of this meaning to other metals is quite possible. The first PIE term **r(e)ud^h-* gave derivatives in Indo-Iranian, Italic, Balto-Slavic, and Germanic languages: Sanskrit *lohá-* 'red metal, copper, iron', Middle Persian/New Persian *rōy* 'copper, brass', Balochi *rōd* 'copper' < Proto-Indo-Iranian **h₂raud^ha-*; Latin *raudus* 'piece of copper, copper coin';⁴ Russian *ruda* 'ore' < Old Church Slavonic *ruda* 'ore, metal', Upper Sorbian *ruda* 'iron ore', 'red earth'. Middle High German *erze*, German *Erz* < **arutja-*, Old Dutch *arut*, Old High German *aruzzi*, *erizzi*, *aruz* 'ore' < **aruta-*, Old Saxon *arut* 'ore', Old Norse *rauði* 'bog iron ore', Old Norwegian *ørtog* 'one-third value of copper coin'. Derivatives of the second term **h₂aye/os-* are found in Indo-Iranian, Italic, and Germanic: Sanskrit *áyas-* 'metal, copper, iron', Avestan *ayah-* 'metal, iron', Latin *aes* 'ore, copper, bronze', Umbrian *ahesnes*, Gothic *aiz* 'metal coin', Old High German *ēr* 'ore', *ērīn* 'bronze', Old Icelandic *eir* 'ore', Old English *æren*.⁵ Crucially, the derivatives of the original word in Germanic differ from those in Slavic, Indo-Iranian, and Italic by the presence of prefix *a-*, so the Proto-Germanic word is reconstructed as **arut-* 'ore'.⁶

Since both variants can be found in the same branch of the IE languages, they coexisted at a time when these branches had not yet diverged. This applies, therefore, to the entire PIE stage, including the late stage, when the languages were relatively close to each other and contacts had not yet been lost.

The problem is the presence of two words with similar meanings in different branches. This suggests that they may have arisen at different times or may have denoted slightly different materials. Regarding the term **h₂aye/os-*, it has been assumed that it could have meant 'bronze', although no justification has been provided. However, it clearly denoted

both metal and ore.⁷ It has been suggested that this word may derive from a hypothetical PIE **h₂ei-* 'fire', although this reconstruction does not seem convincing.⁸ The latter is true, since a different word for 'fire', **p^hHHur*,⁹ is reconstructed for PIE based on the presence of derivatives in a number of languages.¹⁰ As a result, the word, although undoubtedly PIE in form, remains without reliable etymologies.

Against this background, the etymology of another word **r(e)ud^h-* is quite clear. It is related to the PIE word for the red color, which is clearly reflected in a series of derivatives in various IE languages, and these derivatives have parallels in the names for copper.¹¹ Theoretically, this could reflect the reddish-pinkish color of copper. Copper acquires this color after a certain oxidation of the surface, which can manifest itself both in native copper deposits and later in metal objects. A connection with red ores such as cuprite cannot be ruled out, since the word is used for both copper and its ore.

Native copper forms in deposits under reducing conditions, typically separating from hydrothermal solutions, often associated with ultrabasic rocks. The primary mineral from which it forms is the copper sulfide chalcocite (Cu₂S), and in deposits, native copper is associated with it, as well as with the copper oxide cuprite (Cu₂O).¹² Chalcocite ranges in color from lead-gray to black, while cuprite is red. Therefore, the next stage of copper production, involving the smelting of oxidized ores, began with native copper being the primary choice, but increasingly, a mixture of copper and cuprite began to be used. This led to the formation of the word for copper and ore, referring to their shared color characteristics. Ultimately, this situation reflects the stages of use of both native copper and its mixture with cuprite.

The fundamental conclusion is that this PIE stage involved not only the use of finished metal but also its smelting from ore, as derivatives in most languages have both the meanings of 'metal' and 'ore'. This implies that ore smelting took place in the PIE area. This calls into question the common belief that the PIE stage should be associated with the Yamnaya culture of Eastern Europe, where ore was not mined, with the exception of the far eastern periphery, where such mining was assumed at the Kargaly mines.¹³ However, the idea of large-scale mining activities during the Yamnaya period at Kargaly is unfounded. The majority of mines of the Kargaly field is dated to the Russian period; excavations have revealed the exploitation of the mines by the Srubnaya people of the LBA,¹⁴ and comparisons of the chemical composition of

⁷ GAMKRELIDZE/IVANOV 1995, 616.

⁸ THORSØ *et alii* 2023, 108.

⁹ GAMKRELIDZE/IVANOV 1995, 605.

¹⁰ Hittite **pah^hur*, Tocharian A *por*, Tocharian B *puwar*, Armenian *hur*, Greek *pūr*, Umbrian *pir*, Old Icelandic *fúrr*, Gothic *fōn*, Old English *fȳr*, English *fire*, Old High German *fuir*, German *Feuer*, Old Prussian *fanno*.

¹¹ GAMKRELIDZE/IVANOV 1995, 616; THORSØ *et alii* 2023, 109. See also words with meaning 'red' in IE: Sanskrit *lōhita-/rōhita-*, *rudhirá-*, Latin *ruber*, Homeric Greek *ἐρυθρός* [*eruthros*], Tocharian B *ratre*, Old Irish *ruad*, German *rot*, Old English *read*, Old Russian *rud'*, etc. Compare the footnote above with the words for copper in the same languages.

¹² CHUKHROV 1960, 29, 30.

¹³ CHERNYKH 2007, 66, 92–95.

¹⁴ Abbreviations used in the article: IE – Indo-European, PIE – Proto-Indo-European, EBA – Early Bronze Age, MBA – Middle Bronze Age, LBA – Late Bronze Age.

⁴ The Latin word *cuprum* is associated with the name of such a significant copper-producing center as Cyprus, leading to the term *aes cyprium* 'Cypriot copper'. Later, *cyprium* was replaced by *cuprum* (MUHLY 1973, 174, 175). However, this is a late phenomenon and is irrelevant to the problem under consideration.

⁵ GAMKRELIDZE/IVANOV 1995, 614, 616; THORSØ *et alii* 2023, 108, 109.

⁶ THORSØ *et alii* 2023, 109.

copper objects of the EBA cultures in Eastern Europe with Kargaly ores are unreliable.¹⁵ Regardless of this, hypothetical PIE migrants to Europe would have begun their journey not from the Urals, but from the northern Black Sea steppes, where this terminology could not have arisen, especially in such a distinct form and being present in all branches of the IE language. What is crucial in this case is that this PIE term is related to the PIE vocabulary for color.

The situation in Anatolia is more suitable for this terminology. There, the first finds of native copper artifacts appeared in the Neolithic, from the end of the 9th to the first half of the 8th millennium BC (Çayönü Tepesi, layers 2-6, Aşıklı Höyük, layer II). Around 5000 BC, the remelting of this metal began, and very soon oxidized copper ores, associated with native copper, began to be added to the melt. However, relatively large-scale production of copper artifacts only began in the Late Chalcolithic, around the 4th millennium BC.¹⁶ This corresponds to the beginning of the disintegration of the PIE language, sometime between 7613 and 4735 BC.¹⁷

There are, however, some odd situations with this term. It has an undoubted Sumerian parallel in the word *uruda*, *urudu* 'copper', and the existence of a Proto-Sumerian form **burudu*, which derives from the Akkadian name for the Euphrates, *Purattu*, a river where copper was smelted from ore, is also possible. In this case, borrowing is only possible from Sumerian to PIE, and not *vice versa*.¹⁸ This possibility has also been considered by other authors, who note that the pre-Proto-Germanic stem **arud-* best corresponds to Sumerian, while **ruda-* is reconstructed for Slavic, and **raud-* for Common Italic (see the footnote above for Germanic variants). In this case, the appearance of the prefix *a-* is significant, bringing Sumerian closer to Proto-Germanic and Italic words. However, by locating the PIE homeland in the steppes of Eastern Europe, they did not allow for the possibility of direct borrowing, classifying these words as *Wanderwörter*.¹⁹ Another proposed explanation was that Celtic, Italic, and especially Germanic borrowed the word from the so-called "substrate language of Europe".²⁰

In principle, in the case of the Italic variant, we may allow for the vowel shift and bring it closer to the Proto-Germanic form, but Balto-Slavic and Iranian words differ significantly. Therefore, in this case, we should consider the possibility of a borrowing of the Sumerian word into Proto-Germanic (possibly into Proto-Italic). However, without the prefix, cognate words are found in all Indo-European languages. Does this mean that they all received this loanword from

the Sumerian *Wanderwort*, but without the prefix? And what about the aforementioned assertion of the same authors that this word goes back to the PIE word meaning 'red'? The North Caucasian languages of the Near East, located between the Sumerians and the Indo-Europeans (wherever they lived), used different terminology for copper: *kabali* in Hurrian and *kinawar* in Hattic.²¹ Therefore, these IE terms were not borrowed from the Near Eastern languages.

There is another paradox. The Germanic variants fall into the well-known cluster of European words with the *a-* prefix, which is used to argue for the presence of a pre-Indo-European substrate in Europe. An identical prefix is present in the Hattic language, and its relationship with Sumerian is assumed. Therefore, it is supposed that the Sumerians and Hattians inhabited Anatolia and Mesopotamia in the 3rd millennium BC, before the arrival of the Indo-Europeans, and at that time the word for 'copper' in Sumerian was **aruta*, which became *urudu* in the 2nd millennium BC. However, the earlier variant is almost identical to the Germanic **arut* and is close to the Latin *raudus* 'ore'. This latter proves, according to proponents of the steppe IE homeland, the presence in Europe of a pre-Indo-European substrate that was linguistically close to Hattic and Sumerian.²² This eliminates the need to search for a complex path for the word's appearance in Proto-Germanic and Proto-Italic. This paradox can also be explained by the undeniable fact that the Neolithization of Europe resulted from the migration of tribes from Asia Minor that may have had some kinship with the Hattians and Sumerians. In this case, the Proto-Germanic peoples could have acquired this prefix through contact with this substrate. However, the Neolithization of Europe occurred long before the invention of metals, so assuming the same word originated in Sumerian and its hypothetical relatives in Europe is unjustified. And what about the related Balto-Slavic and possibly Indo-Iranian forms?

Moreover, this does not explain how Sumerian acquired a root with a distinctly PIE meaning, going back to color terminology. Furthermore, it had a prefix that was not typical of Sumerian nouns but resembled a Proto-Germanic stem. Moreover, the only surviving isolate of Neolithic European languages is Basque. It is indeed distantly related to Hattic, as it belongs, along with the North Caucasian and Yeniseian languages, to the Dené-Caucasian family.²³ However, prefixes are generally uncommon in Basque, and there is no reason to suspect that they existed in the Neolithic era, persisted until the arrival of Indo-Europeans, and then disappeared. However, the prefix in question is quite typical of Hattic, where it was used to denote an object in the 3rd person singular. It is also present in North Caucasian languages, and has the same function.²⁴

All of the above problems are easily resolved if the PIE homeland is localized in the Near East. A common name for metal and ore, derived from the stem **r(e)ud^h-* and the word for color, could have emerged in PIE around the time when copper smelting from ore began. It can be assumed, however,

¹⁵ See in details GRIGORIEV 2015, 416–419.

¹⁶ YALÇIN 2000, 25.

¹⁷ HEGGARTY *et alii* 2023, tab. 1.

¹⁸ GAMKRELIDZE/IVANOV 1995, 616–617. In the Akkadian language, copper was designated by the same Sumerogram URUDU (*werium* / *erū*) (EROL 2019, 793). This is probably a phonetic transformation of the same word.

¹⁹ Literally, 'wandering words'. It is a curious concept we constantly meet in linguistic studies. When there is a lack of understanding about how a word could have traveled a significant distance, inconsistent with the researcher's understanding of the localization of speakers of a particular language, it is immediately categorized as such, which puts an end to speculation about its origin. For some reason, it never occurs to anyone that perhaps we should question the validity of these generally accepted ideas.

²⁰ THORSØ *et alii* 2023, 109, 117.

²¹ VANSÉVEREN 2012, 210.

²² SCHRIJVER 2018, 361–362.

²³ BENGTON 2004.

²⁴ IVANOV 1983, 119.

that the PIE language was already disintegrating, and the ancestors of the Balto-Slavs and Indo-Iranians inhabited a region where, unlike the Proto-Germanic and Proto-Italic peoples, they had no contact with the Hattians. Since the Sumerian term is clearly related to Germanic and Italic, borrowing from these languages into Sumerian could only have occurred around the 3rd millennium BC, as Sumerian was later supplanted by Akkadian. This likely also indicates that Germanic-Italic names were in use in the regions from which metal was delivered to Sumer.

Anatolian languages, the first separated from the PIE core, display completely distinct vocabulary for copper: Hittite *kuwanna-* 'copper, precious stone' and Luwian *kuwanzu-* 'copper'. Related Greek words include Mycenaean Greek *kuwano-* 'blue glass' and Homeric Greek *κύανος* [*kuanos*] 'dark blue, copper carbonate, steel'.²⁵ This is the most common version, but the etymological problem of transferring the word for metal to glass is confusing.²⁶ In this case, the relatedness of these words is explained by the fact that in the Near East, colored glass and glazes were produced by adding cobalt-containing minerals, but also blue oxidized copper minerals, such as azurite. Therefore, the borrowing of the word from Hittite into Greek is certain, and it occurred in the Near East.

The origin of the Hittite word itself is less clear. A shortened version, *kunnan-*, is suggested, possibly derived from the Sumerian *ku₃-an* 'metal', which has been proposed as a compound of two words: *ku₃-(g)* 'precious metal' and 'sky'. This could be linked, on the one hand, to meteoric iron, and on the other, to azurite, the blue-colored oxidized copper ore. The latter variant is etymologically closer, but it is difficult to determine which meaning was primary: 'copper' or 'azurite'.²⁷ In my opinion, the scenario of borrowing into Hittite from the Sumerian word for both copper and azurite appears dubious, since metals and minerals were brought to Mesopotamia from Anatolia, and not *vice versa*.

There is another hypothesis. It is suggested that the Hittite word derived from the etymon **kwnHos*, whose primary meaning relates to Neolithic tools, 'stone (useful)', and which could be applied to various metals. Thus, it is an inherited word, created on an IE base.²⁸ The crucial point here is that the vocabulary of Anatolian languages differs from other IE terms.

The separation of Anatolian from PIE occurred early, as a result of migration to the northeast of the Balkan Peninsula in the late Neolithic (5th millennium BC). Subsequent return migrations of these tribes at the transition from the Chalcolithic to the EBA at the end of the 4th millennium BC led to the appearance of speakers of Anatolian languages in Asia Minor.²⁹ Thus, the separation of Anatolian from the PIE core occurred at a time when the transition to ore smelting had not yet been realized, which provided a unique terminology for copper and copper minerals in this group. Its similarity to Sumerian can be explained by trade relations,

but the IE source from Asia Minor for borrowing into Sumerian seems more likely because copper was supplied to southern Mesopotamia from the north.

The connection between Greek words and Asia Minor ones is noteworthy, as it may indicate an Asia Minor origin for the Greeks. The Greek words cited above are not the only such example. Two words for copper are known in Greek: Homeric Greek *χαλκός* and Mycenaean *ka-ko*. They are related to the Hattic term *hapalki* 'iron', which gave derivatives into Hittite and other Near Eastern languages. A proto-form **g^hlg^h* has been reconstructed for Greek, which is natural for borrowings from Anatolian languages into Greek. Based on phonetic characteristics and the chronology of Mycenaean texts, this borrowing has been dated to the 3rd millennium BC.³⁰ The problem here is, first and foremost, the meaning of the word, as it is difficult to imagine the beginning of the use of the name for iron to denote copper at this early period. Researchers have also cited another problem: the disappearance of the middle consonant *p* in Greek, which could indicate a borrowing from another Anatolian language, although the Eastern origin of the Greek word is undeniable.³¹ This is also supported by the presence of an Akkadian equivalent, *ḪABALGINNU*. Thus, the Hittites used a Hattic word and Sumerogram.³²

The first problem is resolved by the fact that the Hattic word for iron, *hapalki*, was itself borrowed from the Proto-West Caucasian word **ɬIwə-pəɬə* 'copper', with the palatalized velar lateral rendered as *lki*. For Proto-Abkhaz-Adyghe, **ɬIwəɬwV* 'iron' is reconstructed, also comparable to the Hattic word, from where it could have entered Greek.³³

Overall, this means that the borrowing of the word into Greek occurred in the area of the early West Caucasian languages, to which Hattic was also closely related. However, the borrowing occurred via Hittite, that is, after the Hittite language separated from Anatolian languages and came into contact with North Caucasian languages. This is consistent with the hypothesis that Proto-Greek developed in northeastern Anatolia and the subsequent migration of its speakers westward around the middle of the 3rd millennium BC (EBA II), and from there to Greece around the 24th century BC (EH IIB).³⁴ This coincides with both the area and the chronology of this borrowing.

However, some IE languages have terminology for copper that is difficult to associate with the Near East. Above all, this is the Proto-Slavic form **mědь* (Old Church Slavonic *mědь*, Russian *méd'*, Czech *měď*, Serbo-Croatian *mjěd*, Slovenian *mêd*).³⁵ It has been suggested that it is related to color and to Hittite *miti-*, *mit(t)a-* 'red, red wool'.³⁶ However, this seems semantically unreliable, as the Slavic word for 'red' was definitely different, and Hittite had no similar word for

²⁵ GAMKRELIDZE/IVANOV 1995, 615.

²⁶ VANSÉVEREN 2012, 211.

²⁷ THORSØ *et alii* 2023, 109.

²⁸ VANSÉVEREN 2012, 212.

²⁹ GRIGORIEV 2023b, 14, 17.

³⁰ IVANOV 1977, 226–228.

³¹ THORSØ *et alii* 2023, 109–110.

³² VANSÉVEREN 2012, 204–205.

³³ STAROSTIN 1985, 303–304; KASYAN 2010, 184. There are also other North Caucasian names for copper that have no IE parallels: Proto-North Caucasian **riɬ(w)E*, Proto-Nakh-Dagestani **riɬwV*, Proto-Lezgin **jiɬw'a* (STAROSTIN 1985, 303).

³⁴ GRIGORIEV 2022b; GRIGORIEV 2023b, 24.

³⁵ THORSØ *et alii* 2023, 110.

³⁶ IVANOV 1989, 239.

'copper'. Therefore, the IE roots of the word are unclear, and its etymology is unknown, but its similarity to Celtic **meid-ni-*, which is reconstructed from Old Irish *méin* and Middle Welsh *mwyn* 'ore, metal', is noteworthy. Another Proto-Celtic term, **omiio-* (Old Irish *umae* 'copper, bronze, brass'), exists. It is believed to be related to Proto-Celtic **omo-* 'raw, crude, untreated', and this word may have been used for crude metal, later narrowing its meaning to bronze.³⁷

It is possible that the word was borrowed into Proto-Celtic from Hittite, as it also has no Celtic etymology and cannot be associated with the red color, typically associated with copper and ore. The word **roudo* 'red', which originated from PIE, has been reconstructed for Proto-Celtic (Goidelic: Old Irish *ruad*, Middle Irish/Irish/Scottish *ruadh*, Brittonic: Welsh *rhudd*; Cornish *rud*; Breton *ruz*).³⁸ Therefore, under standard circumstances, we would expect it to contain words derived from this stem. If such a borrowing did occur, then, taking into account the above data on the influence of the Hattic language on this terminology in Proto-Germanic, the formation of Proto-Celtic word must have occurred somewhere in a neighboring area.

It is very problematic to trace the word back to the Balto-Slavic unity, since the Baltic languages have completely different names for copper: Prussian *vargien*, Lithuanian *vārias*, Latvian *vars* 'copper', Prussian *auwerus* 'slag'. It is obvious that this word is related to the IE terminology for heat treatment, primarily boiling: Russian *varit'*, Lithuanian *virti*, Latvian *varīt* 'to boil, to simmer', Slavic **u-var*, *varъ* 'boil', Armenian *varem* 'I light', Albanian *vorbë* 'clay cauldron for boiling', Tocharian A *wrāt* 'to boil', Hittite *uar* 'to burn'. Since this terminology is associated with Balto-Slavic blacksmithing terms (Prussian *autre* 'forge', *wutriis* 'blacksmith', Middle Bulgarian *вътр*, Serbian *вѣтр*), it is possible that there was a Proto-Slavic (e.g. **vbrēti* 'boil') and Balto-Slavic stem meaning 'copper'. It was preserved in the Baltic languages, but was replaced in Slavic during the Common Slavic stage.³⁹

At first glance, this seems understandable. After migrating, the Balto-Slavs found themselves in the barren regions of northern Poland and the eastern Baltic, importing copper and melting it into objects, which could have led to the development of terminology related to boiling. Borrowing of Celtic words for copper into Slavic is also possible, as the Celts at that time lived in copper-rich regions of Central Europe. Moreover, some Slavic groups (probably in the southwest) retained PIE terminology related to copper and ore, but it shifted primarily to the meaning 'ore'. In this case, the terminology for copper in the Balto-Slavic languages offers no clue to the PIE homeland question, as it developed after migration from the original area and was associated with the meaning 'to melt/boil'.

However, this terminology clearly points to migration routes. The Balto-Slavic word for copper is borrowed into Finno-Ugric languages: Mari *βūrjeñe*, Udmurt *īrgon*, Komi-Zaryan *īrgen* (→ Mansi N *aryen*, etc.) < **ūryzn3*, suggesting

a connection with the Baltic languages and, as we see, a borrowing into Mansi of the Ugric group localized in the Transurals from the Komi-Zyryan language of the Western Urals.⁴⁰ However, this reconstruction already incorporates the idea that in antiquity, the Balts, not the Slavs, lived in Eastern Europe, and this term was transmitted from them first to the Finno-Permic languages, and from there to the Ugric languages. This could only have occurred after the split of the Balto-Slavic languages, which is dated to around the mid-13th century BC.⁴¹ However, the spread of copper and bronze into the forest zone occurred much earlier. By the 13th century BC, these technologies were already widely known there, and their most intensive spread began with the Seima-Turbino and Fyodorovka migrations in the first half of the 2nd millennium BC. Therefore, if V.V. Ivanov is correct in reconstructing the Balto-Slavic origin of this word, it marks borrowings from Balto-Slavic at a stage when the Finno-Ugric languages were just beginning to split into Finnic and Ugric branches, and this Balto-Slavic migration took place on both sides of the Urals. Later, the Slavs replaced the word for copper with a Celtic word.

The first, extremely rare, copper artifacts appeared in the forest zone of Eastern Europe and Western Siberia as early as the Eneolithic. In the EBA, influences from the Corded Ware cultures of Central Europe are visible, which led to the formation of the Fatyanovo and Balanovo cultures in the Volga-Kama region. These cultures could have potentially contributed to the spread of Balto-Slavic words in the Finnic language area, but they could not have reached the Ugric area in the Transurals. Moreover, judging by toponymy, these migrants were not Indo-Europeans.⁴² The widespread distribution of metal in the forest zone of Western Siberia and Eastern Europe occurred at the beginning of the LBA in the first half of the 2nd millennium BC, when first the Seima-Turbino and then the Fyodorovka tribes migrated westward from the Altai region. It was this movement that caused the westward shift of some Finno-Ugric tribes and the separation of the Ugric and Finnic branches. It was accompanied by a number of borrowings into the Finno-Ugric languages from the already diverged languages of the northwestern IE group. I am inclined to associate the Seima-Turbino tribes with the Germanic and Celtic groups, and the Fyodorovka tribes with the Balto-Slavic group.⁴³ This movement resulted in profound changes in the metallurgy of the forest zone where the Finno-Ugrians lived, and it is consistent with the linguistic reconstruction of the migration of speakers of European languages from the Near East through Central Asia, Siberia, and Eastern Europe.⁴⁴

The Old Armenian word for copper, *plin3-*, is comparable to Proto-Kartvelian **pilen31-* 'copper'. Therefore, some researchers believe that the word was borrowed into Kartvelian from Armenian, while others think that the source of the word in both languages was some language

³⁷ THORSØ *et alii* 2023, 110.

³⁸ MIKHAILOVA/DYBO/NORMANSKAYA 2002.

³⁹ IVANOV 1977, 234-235; THORSØ *et alii* 2023, 110.

⁴⁰ NAPOLSKICH 2002.

⁴¹ BLÁŽEK 2015, 86.

⁴² GRIGORIEV 2022a.

⁴³ GRIGORIEV 2025a, 55, 63-66.

⁴⁴ GAMKRELIDZE/IVANOV 1995, 831-847.

of Western Asia.⁴⁵ Tocharian B stands apart, where the form *pilke* ‘copper’ is recorded. It goes back to late the IE **PelKo-*, which is derived from PIE **b^hleig-* ‘to shine’.⁴⁶ In my opinion, the Tocharian word is comparable to Armenian and Proto-Kartvelian, and its IE etymology means that Proto-Kartvelian borrowed the word from an IE language. The date of the split of Proto-Kartvelian into Georgian-Zan and Svan was determined based on glottochronology to be around the late 3rd millennium BC.⁴⁷ However, the use of Bayesian phylogenetic methods has allowed the date to be pushed back to the turn of the 4th and 3rd millennia BC, which is supported by a number of other data, including paleogenetics.⁴⁸ This suggests borrowing into Kartvelian around the 3rd millennium BC.

Thus, all words for copper in the IE languages have Near Eastern relations, and these linguistic relations can be dated to at least the 3rd millennium BC.

TIN

The next stage in the development of metallurgy was the invention of bronze, an alloy of copper with tin. In Hittite, the word *ḫarašu-* ‘bronze’ is a loanword from the Akkadian *ḫurāšu* ‘gold’,⁴⁹ reflecting the golden color of bronze and the fact that tin was brought to Asia Minor through Akkadian traders. The reason for this semantic transfer is unclear, as Akkadian had a word for bronze, SIPARRU, while Sumerian used ZABAR (UD.KA.BAR). Therefore, such a borrowing would have resulted in a Mesopotamian term specifically for bronze being adopted in Hittite. The Sumerogram ZABAR in Hittite seems to correspond to another word, *parkui-*, an adjective found with words for tools or vessels, but it means ‘pure, unmixed’, which is unusual for bronze. The word **dankuli-*, *dankuli-*, *dankul-* has been proposed for Luwian, but it has been compared with the word *dankui-* ‘dark, black’, which also does not etymologically correspond to bronze. It has been supposed that the Hattic word for tin, *arzili-*, which is established by correspondences with Sumerian NAGGA (AN.NA) (cf. Akkadian ANNAKKU), could have passed into Hittite as **arzil-*, but this is only a hypothesis.⁵⁰ Thus, a word for tin has not been reliably established for the Anatolian languages, and the available variants of the word in Hattic, Akkadian, and Sumerian are not identical to the IE names, as we will see below.

The Greek word for tin, Homeric Greek *κασσίτερος*, Attic *καττίτερος*, has parallels in other IE and Semitic languages: Latin *cassiterum*, Old Church Slavonic *kositerъ*, Aramaic *qsytr*, *qstyr*, Arabic *qaṣṣīr*, Sanskrit *kastīra-*, but its origin is unclear. It has been suggested to link it to the name of the Kassites, as indicated by the Elamite formation **kassiti-ra* ‘from Kassī’. In this case, a borrowing from Elamite into Indo-Aryan, reflected in Sanskrit as *kastīra-*, cannot be ruled out. Phonetically, a more problematic comparison is

with the reconstructed Early Iranian **ka-čuiθra-* ‘tin’, which contains **čuiθra-* ‘white, lead’, but etymologically, this is the more reliable option.⁵¹ However, the Greek version is quite consistent with terminology associated with the Kassites. A similar connection cannot be ruled out for the Latin and Old Church Slavonic words, but in this case, Greek mediation is more likely. The word reached the Indo-Aryans through the Elamites.

The data presented point to a Near Eastern origin of this word, and its relation with the name of the Kassites seems most justified both phonetically and semantically, although the specific source of borrowing remains unclear. Tin was brought to the Near East from the east through the Zagros passes, which were controlled in some places by the Kassites. Therefore, the appearance of a word for tin meaning ‘Kassite metal’ in Greek, Elamite, and Semitic is justified.⁵² Borrowings into Latin and Old Church Slavonic were secondary. Tin bronze became widespread in Greece with the arrival of the Greeks, who brought with them a number of other innovations. This occurred during the EH IIB period, which is associated with the coming of the Greeks from Asia Minor.⁵³ The spread of the Indo-Aryans is associated with the appearance around the early 3rd millennium BC of cultures with catacomb burial rites in southeastern Iran, which later spread to Afghanistan and southern Central Asia. However, in Iran, there were contacts between the Indo-Aryans and the Elamites living in the Zagros.⁵⁴ Therefore, the borrowing of the word for tin into Indo-Aryan via Elamite is understandable. Thus, the connection between the Indo-Iranian and Greek terminology and Elamite definitely points to the Near East.

In Proto-North Caucasian, the word **ločV* ‘a type of light metal’ is known, which gave later derivatives meaning ‘iron’, ‘tin’, and ‘bronze’.⁵⁵ Therefore, common IE words for tin with Caucasian languages has not been found.

The Latin *stagnum* ‘tin’ is a late imperial word, likely borrowed into Celtic languages (Old Irish *stán*, Welsh *ystaen*, Breton *staen*, Late Cornish *stean*), despite the fact that tin was brought to Italy from Celtic-speaking Britain. However, the source of the Latin word is unclear, and a reverse borrowing cannot be ruled out. Researchers have proposed various alternatives. One is the Greek *σταγών*, *-όνος* ‘drop’, reflecting the process of alloying with molten metal.⁵⁶ This may indicate the spread of alloying technology from Asia Minor to Greece, and then further west into the Italic and Celtic areas. However, previous Celtic and Italic variants are unknown.

⁵¹ THORSØ *et alii* 2023, 115.

⁵² A drawback of this hypothesis is that tin first arrived in Aššur, and from there to Kaneš in Anatolia. In Akkadian, tin was designated by the logogram AN.NA (*annakum*) (EROL 2019, 790). Therefore, it would be expected that this particular name for tin would have penetrated Anatolia and Northern Mesopotamia. A possible explanation is that tin shipments from the east to Anatolia began even before the rise of Assyrian trading colonies. Furthermore, some Near Eastern groups may have become familiar with tin long before its eastern imports, as it was produced in Eastern Anatolia as early as the 3rd millennium BC.

⁵³ GRIGORIEV 2022b.

⁵⁴ GRIGORIEV 2025a, 25–26, 122–136.

⁵⁵ STAROSTIN 1985, 303.

⁵⁶ THORSØ *et alii* 2023, 114–115.

⁴⁵ KLIMOV 1964, 153.

⁴⁶ BLAŽEK/SCHWARZ 2016, 80–82.

⁴⁷ KLIMOV 1994, 40.

⁴⁸ GAVASHELISHVILI *et alii* 2023.

⁴⁹ GAMKRELIDZE/IVANOV 1995, 615.

⁵⁰ VANSÉVEREN 2012, 208–210, 216.

For Proto-Germanic, the word **tina-* (Old Norse *tin*, Old English *tin*, Old Saxon *tin*, Old High German *zin*) is reconstructed, which was borrowed into Proto-Saami **tenē*. This occurred at the Pre-Saami stage, as reflected in the transition **i > *e*. It is possible that in Proto-Germanic this word was related to an earlier stem **dih₂-nó-*, which, in turn, goes back to the PIE root **deih₂-* ‘to shine’. However, this is not certain. Another possibility is a connection with words meaning ‘twig’: Gothic *tains* ‘branch, shoot, twig’, Old Norse *teinn* ‘twig; spit; stake’, Old English *tān* ‘twig, sprout, shoot’, Old High German *zein* ‘twig, stick, ruler, shaft, pipe, bar (of metal)’.⁵⁷ The borrowing into Proto-Sami does not provide a firm date, since it disintegrated around 800 years ago, and the preceding Finno-Sami existed in the range of approximately 3000–2000 years ago,⁵⁸ but the word in Germanic belong to an earlier time span.

In the Balto-Slavic languages, the word for tin is different and can often mean ‘lead’, which looks like tin. Therefore, the Balto-Slavic form **al(a)wa-* ‘lead/tin’ and Slavic **ōlovo* ‘tin’ cannot be excluded (Prussian *alwis* ‘lead’, Lithuanian *álvas*, Latvian *álva*, *álvs* ‘tin’, Old Church Slavonic *olovo*, Old Russian *ólovo*, Serbo-Croatian *ōlovo*, Bulgarian dial. *élavo*, Russian **ōlovъ*, Old Polish *olów*, Slovenian dial. *Olóv* ‘tin’). At the same time, the Russian *ludit’* (to tin), related to tin (since it is used for tinning), is phonetically close to the Germanic word for lead. The Balto-Slavic word for tin has no reliable etymology. Considering that metal names are often associated with their color, one can suggest a parallel with Old High German *elo* ‘pale yellow’ (< **elwa-*).⁵⁹ This suggests that the word for tin was borrowed into Balto-Slavic from Germanic, and tin was somehow related to lead, even though the ores of these metals are not associated with each other. Since Balto-Slavic disintegrated around the mid-13th century BC,⁶⁰ this borrowing occurred in the preceding period. It is necessary to explain how the concepts of ‘tin’ and ‘lead’ became linked, as well as why the meaning ‘pale yellow’ was applied to tin.

This is a rather paradoxical fact, as tin is silvery-white. However, if bronze contains more than 15% tin, the metal becomes pale yellow. A yellow tint also appears in tin with a small amount of copper added. Another paradox is the frequent substitution of the word ‘tin’ for ‘lead’. Although these metals are similar and both melt at low temperatures, lead is less convenient for alloying because it does not dissolve in copper. It can be used for complex castings that do not require finishing by forging. Therefore, theoretically, this terminology could be associated with alloying copper with high-tin bronze, as well as with tin containing noticeable lead impurities.

It is significant that this Balto-Slavic terminology was present in Northern Eurasia, because it was borrowed as the word for tin into the Finno-Ugric languages: Mari *βulno*, Mansi *ōln*, Khanty *olna*, Hungarian *ón*, *ólom* < **woln3*.⁶¹ The presence of the word in the Ugric languages of the Transurals

and Western Siberia indicates either borrowing at the stage of undivided Finno-Ugric, or parallel borrowings into the Ugric and Finnic branches on both sides of the Urals by migrating speakers of Balto-Slavic languages, but after their contact with speakers of Proto-Germanic. The split of Finno-Ugric into the Ugric and Finno-Permic branches occurred between 5371 and 2695 years ago, with a median value of ca. 1900 BC.⁶² Consequently, borrowings from Balto-Slavic into Ugric can be dated to around the early 2nd millennium BC or slightly later. Since the data on the borrowing of the Balto-Slavic word for copper into Finno-Ugric were presented above, this happened along with the spread of tin bronze in Northern Eurasia. The borrowing of the word for tin by the Balto-Slavs from Germanic should be dated to a somewhat earlier time. The borrowing of the word for tin from Germanic into Finnic occurred at the same time or after this.

Thus, while the word for tin in Indo-Iranian, Greek, and possibly Anatolian is of Near Eastern origins, but it is native in Germanic, and in Balto-Slavic, it is a borrowing from Germanic. Borrowings from these languages into Finno-Ugric languages indicate migration near the Finno-Ugric areas, both west and east of the Urals.

TIN IN ANTIQUITY

The first tin alloys appeared in various regions of Anatolia (Cudeyde, İkiztepe, Alişar I, Troya I, Thermi I) in the Chalcolithic in the late 4th millennium BC, but they became more widespread in the EBA, coexisting with arsenic alloys. Only in the EBA II (2700–2400 BC) did tin alloys begin to predominate over arsenic ones.⁶³ In the Northern Balkans, the first tin bronzes appeared in the 5th millennium BC, but they were produced by smelting tin ore, probably stannite, together with copper ore.⁶⁴ The word for tin could not have arisen under these conditions. In the Chalcolithic of Europe and EH I, IIA in Greece, tin bronzes were comparatively rare and in some cases are explained by the smelting of copper ores associated with tin. For Greece and the Balkans, intentional alloys may sometimes be assumed, and some of these may have been delivered from Anatolia. Even within the European Br A1, such finds are rare and are likely related to the import and smelting of copper ore with tin admixture. However, around 2200 BC, tin and bronze production began to spread throughout Europe, although it reached its peak in the late EBA around the 18th century BC, and since the MBA, it became the dominant metal in most of Europe.⁶⁵ However, in the steppe zone of Eastern Europe, tin bronze is unknown until the beginning of the LBA in the first half of the 2nd millennium BC. Therefore, the word for tin could not have formed there; and in Europe, a local terminology could not have emerged until ca. 2200 BC. If we are based on the steppe IE homeland, we may assume that Near Eastern terminology penetrated Greek through trade links. This may explain the borrowing of Greek terminology into the area of Italic. Balto-Slavic loanwords from Proto-Germanic

⁵⁷ THORSØ *et alii* 2023, 116.

⁵⁸ HONKOLA *et alii* 2013, 1248, fig. 2.

⁵⁹ IVANOV 1977, 234; THORSØ *et alii* 2023, 117.

⁶⁰ BLAŽEK 2015, 86.

⁶¹ NAPOLSKICH 2002.

⁶² HONKOLA *et alii* 2013, 1248, fig. 2.

⁶³ YALÇIN 2000, 27.

⁶⁴ RADIVOJEVIĆ *et alii* 2014, 237–247.

⁶⁵ GRIGORIEV 2018, 10–16.

may also be explained in this context. However, borrowings from these languages into Finno-Ugric east of the Urals are impossible to explain, as is the Near Eastern relation of Indo-Iranian words.

In Northern Eurasia, the spread of tin alloys was associated with the migrations of the Seima-Turbino and then the Fyodorovka tribes from east to west across the forest-steppe and the southern forest zone. These migrations likely led to the displacement of some Finno-Ugric tribes west of the Urals and the beginning of their split into the Finnic and Ugric branches. Therefore, the spread of this terminology is associated with this process. Tin in Northern Eurasia was supplied westward from mines in the Kalba and Naryn ranges in eastern Kazakhstan, and this was associated first with the Seima-Turbino and Elunino, and then with the Fyodorovka (Andronovo) populations. The latter adopted the traditions of tin alloys and inherited trade links from the Seima-Turbino and Elunino people. This explains the borrowing of the word for tin from Germanic into Balto-Slavic. Trade apparently involved bronze ingots with a high tin content, which was used for alloying, found at the Transural sites of the Petrovka and Alakul cultures, as well as tin ingots. Bronze ingots found at the Petrovka sites have various shapes: rounded plano-convex (formed in a crucible), rod-shaped, and shaped like certain objects (sickles, chisels, or axes). About half of the crucible bronze ingots and bar-shaped ingots were imported. Similar ingot shapes were widespread, including in the Near East,⁶⁶ but their appearance in the Petrovka culture was linked to supplies from the Altai, with the Seima-Turbino tribes acting as intermediaries.⁶⁷ Therefore, the German word for tin with the meaning of 'twig/bar' is probably connected precisely with this.

To understand the borrowing of words meaning 'pale yellow' from Germanic into Balto-Slavic, we must examine the tin trade. This trade would have met a number of difficulties due to the properties of this metal. Its primary form is white β -tin, but at temperatures below +13.2°C, the metal begins to transform into a gray α -phase, which turns into powder. Appearing only on the surface, this phase gradually transforms the rest of the metal (the "tin pest" effect), and at temperatures of -33°C, this transformation occurs rapidly. However, at less critical temperatures, this process is slow and can be significantly slowed by adding elements such as Pb, Cd, Sb, and Ag, and to a lesser extent, Ni and Cu.⁶⁸ The simplest and most available methods in ancient times were the additions of copper or lead in proportions of 0.5–2%, or the use of high-tin bronzes for alloying. It was not a catastrophic problem, as the powder could be converted into metallic tin by heating or melting, but it was inconvenient for storage and transportation, and the powder was likely less attractive to buyers. In southern countries, this problem was less pressing, but in colder climate, it was significant, and much also depended on the transportation season.

Materials of the early Eurasian LBA show how this problem was solved. Pure tin ingots could be transported in the southern regions. In the famous ship that sank off near the Cape Uluburun around 1320 BC, the majority of the ingots, presumably from the east, were free of lead. However, one third of the ingots, associated with the Southwestern Taurus, did contain lead. Significantly, copper, tin, and silver were mined in this region, suggesting the possibility of producing metallic lead. It is also worth noting that in Alalakh in Northern Syria, the copper raw material was free of lead, but its content increases in tin bronzes.⁶⁹

The earliest tin ingot was discovered in Tomb A of the EBA period at Alacahöyük in Anatolia (ca. 2850–2540 BC). It contained lead (770 ppm), copper (430 ppm), silver (190 ppm), nickel (180 ppm), and iron (130 ppm). Isotopic analysis linked this ingot to the Hisarcık mine near Kayseri in southeastern Anatolia.⁷⁰ The total content of impurities protecting from the "tin pest" in this ingot was 0.14%, which was likely sufficient for this region during the warmer months of the year.

In this case, the connection of these ingots with a silver-producing region is not accidental. Lead had no utilitarian value in ancient times, although occasional finds do occur. The initial appearance of metallic lead was connected with the fact that lead ores contain silver, which was extracted from them by cupellation (oxidation of lead and evaporation of its oxide). This process sometimes yielded metallic lead, which was used for rare small objects and as an alloying element for tin or bronze. This technology was known in Mesopotamia, southeastern Anatolia, and northern Syria (Fatmalı Kalecik, Arslantepe, Habuba Kabira) since the 4th millennium BC, as well as in the Aegean since the first half of the 3rd millennium BC, and it was the only possible method for obtaining silver. After this, lead could be smelted in limited quantities, which was not particularly difficult. For Northern Eurasia, this technology is established by one fragment of lead wire and two slag samples of the Sintashta culture, although silver artifacts are more widely represented.⁷¹ Among the Seima-Turbino bronzes, nine objects made of Cu+Ag alloy were discovered,⁷² indicating familiarity with silver and, indirectly, lead.

In the Transurals, at sites of the Petrovka and Alakul cultures, some of the metal is pure copper or arsenic-containing alloys, but tin alloys are also well presented. Tin bronzes were imported from the east and contained higher lead concentrations. Another pattern has been discovered in the Petrovka culture: the tin content in ingots is, on average, higher than in artifacts, leading to the conclusion that bronze ingots with a high tin content were imported and used to alloy locally produced copper. Sn+Pb ingots were also imported. This metal is comparable to that found in the Seima-Turbino complexes and the Elunino culture. Elunino sites of the Altai contain rare objects made of tin-lead alloys.⁷³

⁶⁶ In particular, the huge quantities of tin that were delivered from the east first to Aššur and from there to Kaneš in Anatolia arrived in the form of plates or ingots (*le'um*) (EROL 2019, 791).

⁶⁷ DEGTYAREVA 2015, 46, 48.

⁶⁸ SPIVAKOVSKIY 1975, 10–11.

⁶⁹ POWELL *et alii* 2021, 5, 8–11, 16.

⁷⁰ YALÇIN/YALÇIN 2020, 234–235.

⁷¹ GRIGORIEV 2015, 163–169.

⁷² CHERNYKH/KUZMINYKH 1989, tabl. 10.

⁷³ DEGTYAREVA/GRUSHIN/SHAYKHUTDINOV 2010, 29; DEGTYAREVA 2015, 43, 45; DEGTYAREVA 2024, 13; DEGTYAREVA *et alii* 2025, 40–45.

Thus, in conditions where temperatures frequently dropped below 13.2°C for most of the year, and were significantly below 0°C for half the year, sometimes reaching -40°C, two methods of tin trade prevailed: 1) tin alloyed with lead, and 2) high-tin bronzes, which were used as an alloy for the local copper. The second method explains the borrowing of the Balto-Slavic word for tin from Proto-Germanic, meaning 'pale yellow', and the first explains the fact that the terminology for tin in some Balto-Slavic languages acquired the meaning 'lead'.

In Central and Northern Europe, the earliest tin ingots with noticeable lead admixture are dated to ca. 1300 BC.⁷⁴ However, the ingots discovered in southwest England have a low lead content.⁷⁵ In fact, lead is present in tin bronzes worldwide. In Europe, the Sn/Pb ratio in Cu+Sn alloys ranges from 8.21 to 10.58 in the 3rd millennium BC. It increases in the EBA-MBA⁷⁶ to a range of 24.69–44.36, indicating a decrease in lead content. In the period 1300–600 BC, this ratio reaches a range of 3.97–8.7, coinciding with the discovery of the corresponding ingots and indicating the use of tin with a high lead content.⁷⁷ This does not mean that this method of tin preservation did not appear earlier, but it only becomes statistically noticeable from this time. The higher lead content in bronzes of the 3rd millennium BC, compared to those of the EBA-MBA, can be explained by the fact that tin was imported from afar, possibly from Anatolia. Moreover, these are relatively rare objects, found primarily in the Balkans and occasionally in Central Europe. This is important for the problem we are discussing, as it indicates the use of tin with lead in alloying. High-tin bronzes are widely represented in Europe, corresponding to the 'pale yellow' meaning discussed above, but their tin content generally corresponds to that of some bronze ingots.

Therefore, this group of Germanic and Balto-Slavic words likely arose in Northern Eurasia between the Urals and Altai, a region with low temperatures throughout the year. However, the most likely area of its initial emergence is southeastern Anatolia, where, in addition to copper mining, tin and silver mining, along with the accompanying lead production, emerged in the 4th millennium BC. Such a technology could only have been invented in an area with all these metals.

TIN IN THE EAST OF THE IE WORLD

It is possible that the above examples of eastern relations of the words under discussion are not limited to this. A surprising situation is observed in the eastern part of the IE area. In Tocharian B, the adjective *lāntaṣṣa* is known, based on which the noun **lant* 'tin' or 'lead' is reconstructed.

This word **lant* has an IE parallel **lento-* with the meaning 'weak, flexible', which characterizes these metals. Related words include Latin *lentus* 'flexible, pliable; sticky; slow', Old Danish *lind* 'soft, gentle', Norwegian *linn* 'flexible, mobile', Old English *liðe* 'soft, gentle', Old High German *lind(i)* 'weak'. This gave a number of derivatives for lead in Germanic and Celtic languages close to the Tocharian form (Middle Irish *lúaide* 'lead' and West Germanic **laudan* 'lead': Old English *lēad*, English *lead*; Middle Dutch *loot*, Dutch *lood* meaning 'lead'; Old Frisian *lād* 'weight, kettlebell'; Middle Low German *lōt* 'lead, metal for alloying and soldering, sinker', but also Russian *ludit'* ('to tin'), and this word is related to tin, not lead, etc.). There is also a connection between the Celto-Germanic **loudu-* 'lead' and the Indo-European **loH₂u-d^hH₁o-* 'made by melting'. A similar connection has been suggested for the Tocharian word **lant*. However, the word **lon* has also been reconstructed for Pre-Classical Old Chinese, as well as an earlier form **lon-tos/-tus*, which could be the source of the word **lāntæ* 'tin' or 'lead' in Common Tocharian, since it is closer than related European words.⁷⁸ This early Chinese form is virtually identical to the Latin *lentus*, suggesting the presence of similar Italic forms. This paradox has been explained by the possibility of borrowing from European languages into Chinese, and from there into Tocharian, a phenomenon that has real archaeological evidence.⁷⁹ However, it can be assumed that the Tocharian word developed in the same area as this Germanic-Celto-Italic vocabulary.

The existence of other borrowings cannot be excluded, recorded in Pre-Classical Old Chinese during the late Eastern Zhou Dynasty (770–221 BC), in the document 'the Rites of Zhou' (*Zhou Li*). There, the term *jin* (金) refers to a metallic substance used for further alloying, containing copper and up to 15% tin. The second component in these recipes, *xi* (锡), is possibly an alloy of copper and lead. The practice of alloying high-tin bronzes with lead was typical of ancient Chinese metallurgy from the Shang Dynasty onward. However, the meanings of both terms may have changed over time, and the exact proportions of the alloys were not universal throughout ancient China.⁸⁰ In modern Chinese, the first character 金 is used to denote gold (SG – but with a phonetic shift – *kin*).⁸¹ Given the similarity of colors of gold and high-tin bronzes, this change in meaning is understandable. However, the identity of this word with the Germanic word for tin is noteworthy (English *tin*, German *Zinn*, Old High German *zin* < Proto-Germanic **tina-*, although given Chinese *jin*, the variant close to **zin-* seems preferable for Proto-Germanic). This phonetic and semantic coincidence cannot be accidental. This indicates the possibility of a borrowing of the word for tin into Chinese from Germanic.

The second character, 锡, is used in modern Chinese to denote tin, and in this case, no phonetic changes occurred (*xi*). Therefore, it is difficult to determine the situation

⁷⁴ KRÜGER *et alii* 2012, 29, 39–40; NIELSEN 2014, 182–183; LING 2014, 118–119, 124.

⁷⁵ WANG *et alii* 2016, 80–84, tabl. 2.

⁷⁶ This was the time of the dominance in Europe of copper from fahlores and, accordingly, antimony-arsenic alloys.

⁷⁷ To obtain these figures, I used the Stuttgart Analysis of European Metals (SAM) database (KRAUSE 2003), selecting only bronzes containing 0.5% tin or more. These will be discussed in more detail in a separate publication. Taking into account that the metal was remelted, I was interested in the average value for the entire metal of each period, and these coefficients reflect this, rather than the tin-to-lead ratio in individual objects.

⁷⁸ BLAŽEK/SCHWARZ 2016, 96–98.

⁷⁹ GRIGORIEV 2025b, 289–291.

⁸⁰ POLLARD/LIU, 2022, 1, 12.

⁸¹ In Chinese, this character not only means 'gold', but has a broader meaning of 'metal', and in combination with others can denote different metals (BLAŽEK 2017, 293).

in archaic Chinese when this borrowing was possible, as words emerged not only for tin itself but also for various tin-based alloys. Perhaps we are dealing with the same interchangeability of the meanings of the word for tin and lead that we see in the Balto-Slavic languages, and which is associated with alloying with tin-lead ingots.

It should be noted that in China, tin bronzes of the Shang and Zhou dynasties have very high lead contents, often exceeding 1%. Binary Sn-Pb alloys are also found.⁸² Thus, with the formation of the developed Chinese bronze industry in the Shang period, the technology of alloying tin with lead, which originated in southeastern Anatolia, is also present.

The widespread use of tin alloys, complex castings, and the appearance of the first objects inheriting Seima-Turbino prototypes in China began in the Erlitou III period, which preceded the beginning of the Shang Dynasty (Erlitou IV). This coincides with the emergence of a series of borrowings from Proto-Germanic into archaic Chinese, including culturally significant terms related to metallurgy, weapon, social life, and wheeled transport.⁸³

Thus, the terminology for tin in the Balto-Slavic and Germanic languages is not a PIE heritage. It developed no earlier than the early 2nd millennium BC, on its own foundations after the emergence of these language groups. Its eastern connections in the Finno-Ugric and Chinese areas are noteworthy, indicating migrations to Europe via Asia.

LEAD

In general, the terminology for lead in Germanic, Celtic, and Italic languages reflects its property (like that of tin) of being easily melted. The Proto-Germanic word **bliwa-* 'lead' (Old Norse *blý*, Old Saxon *bli*, Old High German *blīo*, German *Blei*) is presumably borrowed from a non-IE source. However, there are many closely related forms (Proto-Celtic **(ϕ)loudio-* (Middle Irish *lúaide* 'lead'), Latin *plumbum* 'lead', Italic **plo/uNdʰu-*, Proto-(West-) Germanic **lauda-* (Old English *lēad*, Old Frisian *lād*, Dutch *lood* 'lead'), Berber **būldūn*. An original form **pleu-* 'to flow, float' has been suggested, but this is not entirely reliable. Nevertheless, all these words are clearly related.⁸⁴ In this case, the Berber form does not at all indicate a Near Eastern origin for the word. But it is semantically and phonetically close to the words for tin in European and East Asian languages discussed above. Therefore, its IE origin seems most likely.

The specific Balto-Slavic forms for the word lead (Proto-Slavic **svinъsь*: Russian *svinéc*, Slovenian *svínec*, Lithuanian *švinas*, Latvian *svins*) likely derived from Balto-Slavic **šwein-/šwin-* and from IE words meaning 'light, white'. The situation is different with the Armenian word *kapar* 'lead', which has parallels in Akkadian *abārum* and Hurrian *abari* 'lead' and *kab(a)li* 'copper'. Therefore, the exact borrowing route is difficult to determine, but it clearly occurred in the

Near East.⁸⁵ This is consistent with what we discussed above: lead appeared earliest in the Near East (4th millennium BC). The Hittite word *šulai-* is isolated and shows no connections with other languages.⁸⁶

Thus, the Celto-Germanic-Italic forms of the word could have developed in one area, and the Balto-Slavic forms in another. The former are possibly related to some Near Eastern languages (which is not guaranteed), but the Balto-Slavic forms developed independently. Since lead was not produced intentionally in the Bronze Age, but was obtained by smelting silver from lead ore, this could have occurred in an area adjacent to ancient silver production centers. Accordingly, Eastern Europe can be excluded from the list of candidates, as finds of lead are absent there.

SILVER

The connection of lead with silver production leads us to this metal. PIE languages have two words for 'silver'. The first, *h₂(e)rg̃-nt-o-* 'silver', is related to the color **hark'/*h₂erg̃-*, meaning 'white, shining, light-colored'. It is presented in a series of languages: Hittite *harki-* 'white, silver',⁸⁷ Homeric Greek *ἄργυρος*, Mycenaean *a-ku-ro* 'silver', *argēs* 'white, light-colored, silver-colored', Albanian *(a)rgjënt*, Armenian *arkat* 'silver', Sanskrit *rajat-* 'silver', Vedic *árjuna-* 'white, light-colored, silver-colored', Young Avestan *ərəzata-* 'silver-colored', Old Persian *ardata-* 'silver', Latin *argentum* 'silver', Oscan *aragetud* 'argento', Old Irish *argat*, Middle Welsh *aryant* 'silver'.⁸⁸ Thus, the word is present in Hittite, Greek, Albanian, Celtic, Italic, and Indo-Iranian. Interestingly, a form such as **harkiyant-* could only have a Hittite origin, as a derivative with the individualizing suffix *-ant-*. This is similar to the corresponding terms in Latin *argentum* and Celtic *arganto*.⁸⁹ Consequently, Celto-Italic terminology and Albanian *(a)rgjënt* were finally formed from the PIE stem through areal contact with Hittite. This contact took place after the separation of Hittite from the Common Anatolian, i.e., around the 3rd millennium BC. Indo-Iranian, Greek, and Armenian did not undergo this transformation.

Tocharian may have had a form descended from this stem, but it is only suggested by the hypothetical borrowing into Old Chinese **ākw* 'silver'. In general, Tocharian A *nkiñc* 'silver', Tocharian B acc. *ñkante*, gen. *ñkantentse* originated from Common Tocharian *oäntæ* < *oñto-*, and are likely borrowings from Sogdian.⁹⁰

For Proto-North Caucasian, the form **ʔerVcwE* 'silver' has been reconstructed – Proto-Nakh-Dagestani **ʔerVc(w)E* (Avar *ʃarac*, Proto-Avar **ʃrci*), Proto-Lezgin *ʃars*, Proto-Abkhaz-Adyghe **rVžwV-nV*). It has also been compared

⁸⁵ THORSØ *et alii* 2023, 117.

⁸⁶ VANSÉVEREN 2012, 215.

⁸⁷ In Anatolian languages, this word is not directly attested, but is reconstructed as **harkant-* (KU.BABBAR-*ant-*) 'silver'. The connection of this word with the white color in PIE is confirmed by Tocharian A *ārki-* and Tocharian B *arkwi* 'white' (THORSØ *et alii* 2023, 108). Therefore, if the proposed reconstruction is correct, the Anatolian word has an IE origin.

⁸⁸ IVANOV 1977, 233; GAMKRELIDZE/IVANOV 1995, 617; THORSØ *et alii* 2023, 108.

⁸⁹ VANSÉVEREN 2012, 212.

⁹⁰ BLAŽEK/SCHWARZ 2016, 99–103, 105.

⁸² LIU *et alii* 2025, 2–5, 8.

⁸³ GRIGORIEV 2025b, 277–291.

⁸⁴ THORSØ *et alii* 2023, 116.

with this IE word.⁹¹ There have also been objections based on the fact that North Caucasian names can be derived from Armenian *arkat*.⁹² However, the similarity of the Old Irish form *argat*, in my opinion, indicates that we are talking about broader IE parallels, and not about the PIE or Proto-North Caucasian stages. Therefore, this term is of Indo-European origin, related to the IE color word, and it reveals clear Near Eastern relations in the form of borrowings into North Caucasian. There is no obvious relation with other languages of Western Asia: Sumerian KÙ.BABBAR (KÙ 'metal; to be clean, bright', BABBAR 'white'), Akkadian KASPU, Hurrian *u/išḫuni*, Hattic *ḫattuš*.⁹³

Derivatives of this IE word were borrowed from Alanic **æzvestæ* 'silver' into separate Finno-Ugric languages independently and on different sides of the Ural Mountains: Hungarian (*ezüst*) and Permian (**äzüs*).⁹⁴

The second group of words extends to the Balto-Slavic and Germanic languages, but its IE etymology is not given: **Slavic**: Upper Sorbian *slěbro*, Lower Sorbian *slobro*, *slabro*, Prussian *silapris*, Ukrainian *sriblo*, Russian *serebró*, Old Church Slavonic *srěbro*, Bulgarian *srebró*, Serbo-Croatian *srébro*, Slovenian *srebró*, Czech *stříbro*, Slovakian *striebro*, Polish *srebro*, Polabian *srebrü*; **Baltic**: Lithuanian *sidābras*, Old Lithuanian *sidabras*, Latvian *sidrabs*, *sudrabs*, Prussian *siraplis*; **Germanic**: PG **silubra-* > Gothic *silubr*, Old Germanic *silabar*, Old Icelandic *silfr*, Old Saxon *seolfor*. The Celtiberian *šilaPuř* unexpectedly joins this group.⁹⁵

Caucasian parallels have also been suggested for this word.⁹⁶ In particular, the Kartvelian word *were₁xl* 'silver' of the Georgian-Zan period was proposed to derive from this IE word. Other researchers, while acknowledging this relation, believed the borrowing was in another direction.⁹⁷ For example, it was shown that the Old Prussian form is closest to the Georgian-Zan word, suggesting a transformation **werk₁xl* > **s(e)rwl* > **s(e)rpl*.⁹⁸ In short, the situation with Kartvelian is not entirely clear. At the same time, similarities are observed with terms for silver in Basque and Semitic languages: Basque *zil(h)ar* (< **zilpar?*), Proto-Semitic **šarp-* (Akkadian *šarp-*,⁹⁹ Arabic poet. *šarīf*), Berber **zřip-/zřūp-* > *azref*, *azerfa*, Hausa *azurfā*. There are also similarities with late Anatolian forms such as Lydian Σίβρυς.¹⁰⁰ This phenomenon has been explained by the fact that this is a *Wanderwort*, which spread from the Mediterranean after the disintegration of the Indo-European languages.¹⁰¹

It is difficult to disagree with the chronology of this word's origin. However, Kartvelian, Lydian, and Semitic parallels point to the Near East. The word's presence in Berber, which separated in the Neolithic, may indicate a later introduction

from the Near East, possibly with the Phoenicians. The Phoenician colonization of Iberia, primarily for silver mining, could explain the word's presence in Celtiberian. Important for our problem is that this word is present (besides Lydian) in only two IE groups: Balto-Slavic and Germanic. They likely borrowed the word in the Near East via Kartvelian, as it is highly doubtful that it reached them through North Africa and Iberia.

From Germanic, this word was borrowed into Sami in the form *s'ilp* 'silver'.¹⁰² We discussed above how the word for tin entered Proto-Sami from Germanic, as well as the connection between the Seima-Turbino tradition and Proto-Germanic. In this context, it is indicative that the Seima-Turbino bronzes are known in northern Eastern Europe and southern Finland.¹⁰³

Thus, overall, both versions of the IE word for silver demonstrate Near Eastern relations. Moreover, the Italic, Celtic, and Albanian names suggest their formation in the areal contact with Hittite within the 3rd millennium BC. Balto-Slavic and Germanic terminologies are interrelated, and Germanic name penetrates into Sami.

GOLD

In many IE languages, the word for gold goes back to a common PIE stem **Hau-s-/Hw-os-/H₂ues-*: Latin *aurum* (< **ausum*, cf. Sabine *ausom*), Armenian (*v*)oski; Proto-Baltic **ausas*: Old Lithuanian *ausas*, Old Prussian *ausis*, Lithuanian dial. *áusas*, Lithuanian *áuksas* (< **auskas*), Latvian *auzas*; Tocharian A *wäs* 'gold', Tocharian B *yasa* < **wés-/wāsā/wjāsā* 'gold'.¹⁰⁴ The presence of a term for gold that goes back to a common PIE stem means that gold was well known in the PIE area.

Armenian (*v*)oski 'gold' is comparable to Sumerian *guškin* 'gold'.¹⁰⁵ Since the Armenian word originated from the PIE base, it could be assumed that this word appeared in Sumerian from Armenian or another early IE dialect in the 4th–3rd millennia BC. A connection has also been noted between this terminology and Hurrian *ušḫu* 'silver'.¹⁰⁶ In this case, it seems that the Armenian source is closer, which is consistent with well-known Hurrian-Armenian contacts. However, Hurrian had a different word for gold: *ḫiyari*, *ḫiyaruḫḫu* / *ḫe(iar(i)-o-ḫḫe*. Furthermore, the Sumerian word for gold was expressed by a two-part ideogram, KU₃-SIG₁₇, meaning 'silver' + 'yellow'.¹⁰⁷ Therefore, the connection between the IE terminology and Near Eastern one is questionable. The Akkadian word *hurāšum* (KÙ.GI/KÙ.KI) 'gold'¹⁰⁸ has no direct IE parallels. Thus, the Sumerian-Akkadian terminology for gold clearly demonstrates no connection with the IE vocabulary. The people of Southern Mesopotamia and the Indo-Europeans became acquainted with gold independently.

⁹¹ STAROSTIN 1985, 303.

⁹² GUSEYNOV/MUGUMOVA 2012, 184.

⁹³ VANSÉVEREN 2012, 212.

⁹⁴ NAPOLSKIKH 2022, 72–73.

⁹⁵ IVANOV 1977, 231; GAMKRELIDZE/IVANOV 1995, 617; THORSØ *et alii* 2023, 108.

⁹⁶ IVANOV 1983, 104.

⁹⁷ KLIMOV 1964, 83–84; GAMKRELIDZE/IVANOV 1995, 617.

⁹⁸ IVANOV 1977, 232.

⁹⁹ However, in the Assyrian documents of Kaneš, silver is *kaspum* (KÙ.BABBAR) (EROL 2019, 781).

¹⁰⁰ IVANOV 1977, 232; THORSØ *et alii* 2023, 108.

¹⁰¹ THORSØ *et alii* 2023, 108.

¹⁰² KERT 1966, 168.

¹⁰³ CHERNYKH/KUZMINYKH 1989, fig. 2.

¹⁰⁴ IVANOV 1977, 233; GAMKRELIDZE/IVANOV 1995, 218; BLAŽEK 2017, 271–274, 281; THORSØ *et alii* 2023, 105.

¹⁰⁵ GAMKRELIDZE/IVANOV 1995, 218.

¹⁰⁶ IVANOV 1977, 233.

¹⁰⁷ VANSÉVEREN 2012, 214; BLAŽEK 2017, 285–286.

¹⁰⁸ EROL 2019, 784.

In Indo-Iranian, Germanic, and Balto-Slavic languages, the term for gold is different. A transition took place to a name associated with the yellow color, which is based on the word **ǵʰel-* 'yellow':¹⁰⁹ Phrygian γλουρος; **Indo-Iranian** **zʰrHanja-* > Vedic *hiraṇya-*,¹¹⁰ Prakrit *hiraṇṇa-*, Avestan *zaranya-/zarañiia-*, Old Persian *daraniya-*, Scythian Ζάρινα 'gold'; **ǵʰ(H₃)-to-*¹¹¹ : > **Germanic** **gulpa-/gulda-* 'gold' > Gothic *gulþ*, Crimean Gothic *goltz*, Old Norse *gull*, *goll*, Norwegian, Faeroese, Icelandic *gull*, Swedish, Danish *guld*, Old Frisian, East Frisian, Old Saxon, Old High German, Old and Modern English *gold*, Middle High German, Old Low Franconian, Old Dutch *golt*, Middle Dutch *golt*, *gout*, *gaut*, Dutch *goud*, West Frisian *goald*, North Frisian *gul*; **Baltic**: *ǵʰel(H₃)-to-* > Latvian *zēlts* 'gold; golden'; **ǵʰol(H₃)-to-* : > **Slavic** **zōlto* 'gold' > Old Church Slavonic *zlato*, Bulgarian *zlátó*, Macedonian *zlato*, Serbo-Croatian *zlâto*, Slovenian *zlató*, Slovak, Czech *zlato*, Polabian gen.sg. **zlâtə*, Upper/Lower Sorbian, Kashubian, Polish *zloto*, Belorussian *zólata*, Ukrainian, Russian *zóloto*.¹¹²

At first glance this suggests that the Indo-Iranians, Proto-Germans, and Balto-Slavs arrived in an area where color-related terminology for gold was used. However, Baltic retains traces of earlier PIE terminology based on the Proto-Baltic form **ausas* (see above). This means that it also existed in the Balto-Slavic languages. Color-related forms are secondary, formed during or after migration from the PIE area. It is also significant that all these groups used their own word for color, which means that their languages had already diverged by that time. Moreover, the presence of differences in the root of the word between Baltic and Slavic suggests that the Balto-Slavic unity had already begun to disintegrate at the time this terminology was formed. In any case, dialectal differences emerged in the language.¹¹³ The common basis indicates that this name appeared in Indo-Iranian at a time when the Indo-Iranian languages had not yet diverged.

In many regions of the Roman Empire, the word for gold was replaced by words derived from the Latin *aurum*, such as the Albanian *ar*.¹¹⁴ The same root is found in names in

Celtic languages: Old Irish *ór*, Middle Welsh *eur*, Welsh *awr*, Cornish *our*, Breton *aouer*, Old Breton *ourcalch*. Only a few toponyms and personal names in the Celtic and Thracian areas¹¹⁵ suggest the presence of a Proto-Celtic word **aus-* and similar Thracian and Illyrian words.¹¹⁶ Thus, the original word for gold in the Celtic and Northern Balkan regions had the same PIE stem, further emphasizing that gold was well known in the PIE area.

The most complex situation is with the terminology for gold in Greek, which is due to the extensive contacts of the Greeks with various regions. There is reason to believe that Greek χρῦσός and the earlier Mycenaean *ku-ru-so* 'gold' were borrowed from Semitic languages, presumably from Phoenician: Akkadian *ḫurāṣu*, Ugaritic *ḫrṣ*, Phoenician *ḫrṣ*, and Hebrew *ḥārūṣ* (< **ḫrṣ-*).¹¹⁷ There is a later form χλουνός, recorded by Hesychius of Alexandria (5th century AD), which goes back to the same series of IE terms for gold related to color. Another form with the same relation is χλωρός 'green-yellow, yellowish', which is comparable to Phrygian γλουρος 'gold'. This transition ου > ω in other words characterizes a borrowing from Phrygian into Greek. Thus, it may be an Asia Minor word. Therefore, the Greek terminology may not be entirely original, and the original forms in the language were erased by later layers. A probable surviving trace is the ideogram AURUM in Linear B, which should perhaps be read as **auho-* (or **woha-*).¹¹⁸ If this is correct, the word may go back to some PIE or early IE stem, but it is difficult to say anything definitive.

It is possible that the Proto-Kartvelian word **okro-* 'gold' was borrowed from the Ancient Greek ὄχρος 'yellow, shiny',¹¹⁹ which may indicate a close localization of Proto-Greeks and Proto-Kartvelians. The IE languages, however, show no connections with the Proto-North Caucasian **rVwṣwi* 'gold'.¹²⁰

It is not possible to reliably establish terminology related to gold in Anatolian languages. Researchers have proposed (^{NA4})*ḫušt(i)-*. However, the word describes a flammable and strong material, and it was sometimes identified with amber. Comparisons between amber and gold are found in ancient literature, and this is entirely logical. However, it is possible that this is the same PIE term for gold, to which a suffix has been added (from the forms **H₂us-t-* or **H₂eus-t-*). A relationship with the Luwian adjective *hwi/a-sa-ti-sa* / *hwisti(ya)s(a)* cannot be ruled out. However, in hieroglyphic Luwian, a different term **washa* is found. One mina (SG – i.e., 505 g) of this material is mentioned together with one mina of silver. Anitta's text mentions two cities, *Ḫarkiuna-* and *Wašhaniya-*, the former of which can be linked to *ḫarki-* 'white' or 'silver', which would suggest the latter is associated with gold. This word is sometimes

(BLAŽEK 2017, 274).

¹¹⁵ Thracian names *Auza Scutio* and Αὐζακενθος, Illyrian city Αὐσαγκαλή/*Ausancalione*, rivers *Ausa* (near Rimini, a tributary of the Seine, a tributary of the Murg near the Rhine), *Ausona* in Northern Italy, *Ausenna* (Senna in Tuscany), *Auser* (a tributary of the Arno in Etruria), *Ausaua* (a tributary of the Kyll, which flows into the Mosel), *Ausoba* (in Ireland), *Ausuciates* (an ethnonym near Lake Como in Lombardy).

¹¹⁶ BLAŽEK 2017, 274, 276–279.

¹¹⁷ BLAŽEK 2017, 267; THORSØ *et alii* 2023, 107.

¹¹⁸ BLAŽEK 2017, 268, 294.

¹¹⁹ KLIMOV 1964, 151.

¹²⁰ STAROSTIN 1985, 302.

¹⁰⁹ Sanskrit *hári*, Avestan *zari-* 'yellow'; Latin *fel* 'bile', Old High German *gelo*, German *gelb* 'yellow', Greek *khólos* 'bile', Russian *želtij*, Latvian *dzeltenš* 'yellow', East Lithuanian *želtas* 'gold-yellowish, greenish-yellowish'.

¹¹⁰ In Sanskrit, another word, *hāṭaka-*, is known, which is sometimes associated with a place name, though this is not entirely reliable (BLAŽEK 2017, 271). However, it should be remembered that Sanskrit was significantly reworked by Indian grammarians, and there is no information about its status as a spoken language; this function was fulfilled by Prakrits. Furthermore, Sanskrit absorbed a number of loanwords from earlier substrata of the Indian subcontinent (ELIZARENKOVA 2004). Therefore, it does not fully reflect the normal language evolution.

¹¹¹ A feature of the Germanic and Balto-Slavic languages is the use of the adjective suffix *-to-* when forming the word for gold, and the root base is slightly transformed (BLAŽEK 2017, 271).

¹¹² IVANOV 1977, 234; GAMKRELIDZE/IVANOV 1995, 218; BLAŽEK 2017, 268–271; THORSØ *et alii* 2023, 107.

¹¹³ The modern Russian *želtij* does not contradict this, since the canonical spelling 'želtij' with the typical pronunciation 'žoltij' corresponds to this completely.

¹¹⁴ Later, the Latin *aurum* gave derivatives in a number of Romance languages, in some of them directly (Romanian, Istro-Romanian *áur*; Vegliotic *yaur*; Friulian *áur*, Rhaeto-Romance: Sutsilvan, Grischun *qur*, Engadin (Tschlin) *áur*; Old Provençal, Old Bearnish *aur*; Portuguese, Gallego *ouro*), and in others through Vulgar Latin *ōrum* (Italian, Spanish *oro*, Ladino *or(o)*, Franco-Provençal: Magland *ór*, Vallorcine *ur*; French, Catalanian *or*)

found in the context of sacred objects, and a connection to the Common Tocharian word for 'gold' **wjäsa* is assumed. It has been supposed that the Hittite and Luwian words originated from a common Anatolian proto-form **H₂ues-H₂*.¹²¹ It is also possible that Hittite used the word **kurupšini*, expressed by the Sumerogram GUŠKIN, but this is also not entirely reliable.¹²² Taken together, this suggests that Anatolian words originated from the PIE base, but nothing more. Anatolian forms differ from the basic PIE forms. They developed separately within the Proto-Anatolian area. The similarity between Proto-Tocharian and Anatolian forms may indicate areal proximity.

It is clear that the earliest PIE form for gold was **H₂ues-*, meaning 'to burn; be bright, become (morning) light', and is close to the proto-form of the word for copper. Consequently, it is possible that, precisely in order to reliably distinguish these concepts, some languages switched to a different terminology for gold, related to its yellow color, which was based on the PIE **ǵhelH₃-* 'yellow-green'.¹²³

In principle, this is a perfectly logical idea, since when people first encountered copper, they assigned the general meaning of 'metal' to the word. However, the question remains as to why this occurred only within one group of languages. Furthermore, we saw above that by the time these second forms emerged, the PIE languages had already diverged considerably. In any case, this second form was secondary, while the first is indeed related to the proto-form for copper. This can be explained by the fact that on the early stage, PIE speakers were familiar with the native forms of both metals, which is reflected in the semantics of the name given above. This means that their homeland was located in an area where both of these metals were common in their native form. Moreover, the clear relation between the terminology for copper and ore suggests that the transition from the use of native copper to the smelting of ores took place in the same region. This allows us to exclude Eastern Europe from consideration, and the only acceptable candidate (taking into account the isolated relations of these terms with Near Eastern languages) is the Near East. This general IE terminology is not related to the terms for gold in the languages of Southern Mesopotamia, Sumerian, and Akkadian, and therefore developed further north and independently. In Anatolian languages, terminology for gold developed separately from the main IE core, but also on a PIE basis.

We met two instances of Asia Minor relations of the Proto-Greeks: the borrowing of the word for gold from Phrygian, Greco-Semitic parallels, and a borrowing from Greek into Proto-Kartvelian. We discussed above that Proto-Kartvelian diverged in the late 3rd millennium BC or, according to Bayesian phylogenetics, around the turn of the 4th/3rd millennium BC. Greek separated in the interval of 4930–1999 BC (95% probability), with a median value of ca. 3310 BC.¹²⁴ These figures were also obtained using Bayesian phylogenetics and are therefore quite comparable.

The borrowing of the word from Greek is entirely consistent with a somewhat later split of Proto-Kartvelian. Thus, some Greek terminology for gold developed in Asia Minor no later than the end of the 4th millennium BC. Other words also have Near Eastern origins, but could have been linked to later processes or trade connections.

In the Indo-Iranian, Balto-Slavic, and Germanic languages, this original terminology, whose relics have survived only in the Baltic languages, was replaced by names related to color. This occurred after these languages separated during their migration to their historical habitats. Based on Bayesian phylogenetics, the Indo-Iranian language separated in the range 6395–3645 BC with a median of 4981 BC; the beginning of the Balto-Slavic language is dated in the range 5944–3036 BC with a median of 4465 BC; and that of the Germanic language is dated in the range 4193–1718 BC with a median of 2889 BC.¹²⁵

In this case, we are not discussing the accuracy of the dates, but rather accepting them as relative, since they are based on the same procedure. Gold appeared in Anatolia in the 4th millennium BC. Therefore, the preservation of the common PIE terminology in Baltic indicates the migration of the Balto-Slavic tribes from Anatolia only after this time.

The migration routes of Iranian groups are marked by the appearance of their names for gold in Finno-Ugric languages, but a semantic shift occurred, and this terminology is also used for copper.¹²⁶ Finnic borrowed the word from Germanic languages.¹²⁷ Judging by the examples cited in the footnotes, borrowings from Germanic occurred after the split of Finno-Ugric into Finnic and Ugric branches, but before the split of the Baltic Finnic languages, and from Iranian languages before the split of the Finno-Volgaic, Pre-Finno-Permic, and Ugric branches.

The split of Finno-Ugric into Ugric and Finno-Permic branches occurred in the range of 5371–2695 years ago with a median value of about 1900 BC. The split of Baltic Finnic occurred approximately 1842–687 years ago with a median value of about 800 AD. The Finno-Permic began to disintegrate into Baltic-Finnic and Finno-Volgaic around the middle of the 2nd millennium BC. In the Ugric group, Hungarian is the first to emerge in the range of 4895–1690 years ago (median value of about 1300 BC). Therefore, all these borrowings took place after 1900 BC, but borrowings from Germanic occurred before 800 AD, and from Iranian – after the mid-2nd millennium BC, but possibly before 1300 BC.¹²⁸ These figures are imprecise for two reasons: the imperfections of the method and the possibility of parallel borrowings. Nevertheless, it can be said with certainty that borrowings of words for gold into Finno-Ugric from Germanic

¹²⁵ HEGGARTY *et alii* 2023, tab. 1.

¹²⁶ Volgaic **serñä* > Mordvinian **sīrñä*: Erzya *siñie*, Moksha *širñie* 'gold', Moksha *širñä*, *šeñä* 'copper, brass, silver', *señe*, *šeñe* 'copper, brass', Mari K *šörtñä* 'gold', pre-Permic **serñä* / **sarñä* > Udmurt-Komi *zarñi*, Khanty DN *soññä*, Mansi KU *surñä* 'gold', Ugric **θaraña* > Hungarian *arany*, 'gold; money', Mansi *tarñä*, *tarñä* 'copper', Khanty V *lorñä* 'copper', Khanty Vj. *iorñi* 'copper, brass' (BLAŽEK 2017, 270, 271).

¹²⁷ Finnish *kulta*, Karelian, Ludish *kulta*, Veps. *kuud*, *kuud*, Wotic *kunta*, Estonian *kuld*, Livonian *kūld(a)*; Sami of Norway *golle* 'gold' (BLAŽEK 2017, 270–271).

¹²⁸ HONKOLA *et alii* 2013, 1248, fig. 2.

¹²¹ BLAŽEK/SCHWARZ, 2016, 89, 105; BLAŽEK 2017, 282–288, 294.

¹²² VANSÉVEREN 2012, 214.

¹²³ BLAŽEK 2017, 295.

¹²⁴ HEGGARTY *et alii* 2023, tab. 1.

and Iranian occurred during the LBA of Northern Eurasia, and borrowings from Germanic preceded borrowings from Iranian.

THE OLDEST GOLD AND SILVER IN THE CIRCUMPONTIC ZONE

The most ancient gold in the Circumpontic region are numerous finds from the Varna cemetery in Bulgaria, which can be dated to around the mid-5th millennium BC.¹²⁹ However, finds in the Near East are only slightly later. In Mesopotamia, the earliest gold jewelries are dated from the second half of the 5th millennium BC to the first half of the 4th millennium BC. They were discovered in the Gawra layers XII–VIII in northern Iraq, as well as in Ur in southern Iraq, dated to at least the late Ubaid period. However, later, during the Jemdet Nasr period and until the First Dynasty of Ur, gold objects are unknown.¹³⁰ Later finds of gold, silver, and their alloys are associated with the Royal Tombs of Ur (since the mid-3rd millennium BC). The presence of platinum group mineral inclusions in the gold of these tombs, as well as the inscription on Statue B of Gudea stating that gold came from both the *Ḫaḫum* Mountains and the land of *Meluhḫa*, suggest that its source was northern Afghanistan, as *Meluhḫa* can be localized in the area of Balochistan, Gujarat, Pakistan, and Afghanistan. The *Ḫaḫum* Mountains were located on the border of modern-day Syria and Turkey.¹³¹ In Anatolia, gold, silver, and lead appeared in the late Chalcolithic, in the 4th millennium BC.¹³² Thus, in the Near East, gold first appeared in southern Mesopotamia and only later in Anatolia. This explains the lack of Indo-European parallels in the terminology for gold in Sumerian and Akkadian.

We also discussed above that the Anatolian languages were formed as a result of migration from Asia Minor to the Balkans, with a subsequent return in the 4th millennium BC. The earlier chronology of gold finds in the Balkans compared to Asia Minor explains the isolated position of Anatolian names for gold.

As for silver, the situation is somewhat different, as the word for silver in Semitic languages has Balto-Slavic and Germanic parallels. Silver was delivered to Mesopotamia from Anatolia, and this has been documented even for Sumer. Lead and copper impurities in the silver objects of the Royal Tombs of Ur indicate that silver was obtained by cupellation.¹³³ This may point to the already discussed region in southeastern Anatolia, where copper, tin, silver, and, incidentally, lead were mined and produced.

In the steppe Eastern Europe, gold and silver artifacts are absent during the Eneolithic period. An exception is the Maikop-Novosvobodnaya culture of the EBA, which formed under the Near Eastern influence in the second third of the 4th millennium BC.¹³⁴ Its complexes present many gold and

silver artifacts, including beautifully crafted metalware.¹³⁵ Chronologically, this culture largely corresponds to the Eneolithic steppe complexes such as Khvalynsk-Sredny Stig and Zhivotilovka-Vovchansk, but also to later Yamnaya complexes. Sites such as Repin Khutor and Berezhnovka are often considered early in the latter culture, but this is not entirely accurate. Classic Yamnaya sites are dated to the late 4th – early 3rd millennium BC, and in the early 3rd millennium BC the migration of Yamnaya tribes to Central Europe began. Chronologically, this coincides with the beginning of the Corded Ware Cultures, but the Yamnaya's contribution to their formation was not very significant. The previous substrate of the Globular Amphora culture and the late Eneolithic steppe complexes played a major role.¹³⁶

In the Volga-Ural interfluvium, during the early stages of the Yamnaya culture, jewelry was made of bone. Only three assemblages are known from the developed and late stages: two with silver jewelry (Utyovka 2/1 and Uvarovka 2/2) and one with gold jewelry in a late Yamnaya burial (Utyovka 1/1). Since burials of the developed stage of the Yamnaya culture in the region have some parallels with the Maikop culture, it can be assumed that these objects were imported in the Volga-Ural region from the North Caucasus.¹³⁷

Another group of Yamnaya gold objects is located far to the west. These include four pendants in the lower Danube, two in the Dniester region, and one in the lower right-bank Dnieper. They are dated to the second and third quarter of the 3rd millennium BC.¹³⁸ Silver objects are absent, and it is clear that these gold ornaments are the result of Balkan imports.

Thus, the first, extremely rare gold and silver objects in the Eurasian steppe appeared no earlier than the first half of the 3rd millennium BC, and they were imported from two sources: the Balkans and the North Caucasus. The steppe did not and could not have had its own production of these metals. It is difficult to expect the development of a common Indo-European terminology for these metals on this basis. But even if we accept this possibility, we must associate the spread of Indo-Europeans from the Eastern European steppes with complexes no earlier than this time span, both in Europe and Asia. This is inconsistent with the postulates of the Steppe Theory, which explains the formation of the Corded Ware cultures of Europe as a result of Yamnaya migration. This is not entirely consistent with reality, since these cultures developed primarily due to earlier Late Eneolithic impulses, although the penetration of the Yamnaya culture into Pannonia is also undeniable. Due to the extreme rarity of gold and silver finds in the Eastern European steppe, their imported nature, associated with two different sources, and the complete absence of corresponding deposits in this zone, the development of a common IE terminology for gold and silver was impossible there.

Starting from the LBA, gold is more common, although its finds are not numerous. Seven gold ornaments are known

¹²⁹ KRAUß *et alii* 2017.

¹³⁰ JANSEN/BENATI 2020, 319–321.

¹³¹ HAUPTMANN *et alii* 2018, 100, 118.

¹³² YALÇIN 2000, 25.

¹³³ HAUPTMANN *et alii* 2018, 112.

¹³⁴ REZEPKIN 2012, 76.

¹³⁵ KORENEVSKIY 2003.

¹³⁶ GRIGORIEV 2022a.

¹³⁷ FAYZULLIN 2020, 100, 104, 108.

¹³⁸ RAZUMOV/LASENKO 2020, 23, 31.

from the Seima-Turbino necropolis in Rostovka, Western Siberia.¹³⁹ Since we have proposed a connection between the Seima-Turbino bronzes and speakers of Germanic languages, it is significant that the word for gold was borrowed into Finnic from these languages.

DISCUSSION

As we see from the data presented, the IE languages share not only a common name for copper, what is widely known and actively discussed, but also a number of names for other metals. Moreover, the name for copper is also associated with ore, and it formed in a region where the transition from the use of native copper to ore smelting took place. In the same region, the IE people were familiar with tin, silver, lead, and gold. None of these metals could have been mined in the North Pontic steppes. Copper is an exception, since the Kargaly mines of the Southern Urals are presumed to have been exploited during the developed stage of the Yamnaya culture. However, native copper is rare in sandstones, and there is no evidence that the evolution from the use of native copper to the smelting copper from ore took place in this region. Silver and gold objects in the Eastern European EBA are of Caucasian and Balkan origins and are extremely rare since the first half of the 3rd millennium BC, which could not have ensured the presence of common terminology in all IE languages. Tin appeared in Eastern Europe only in the first half of the 2nd millennium BC, and tin and lead productions were absent there. Therefore, based on metal names, Eastern Europe can be excluded from the candidate for the IE homeland.

One of the reasons for linking IE terminology for metals with Eastern Europe is the presence of a Proto-Germanic word with the prefix *a-*. This prefix and a number of lexical borrowings in northwestern IE languages are explained by the presence of a “substrate language of Europe”, similar to Hattic or Sumerian, but Vasconic and Afro-Asiatic substrates are also mentioned.¹⁴⁰ However, this conception explains obvious linguistic facts by means of a dubious archaeological theory. The logic is simple: if the IE homeland was in the steppes of Eastern Europe, where no population speaking these Asiatic languages existed, then these borrowings were done in Europe, since the Neolithization of Europe had occurred from Asia Minor. Consequently, we must “relocate” various groups with Near Eastern linguistic analogues to Europe, and before that, to Asia Minor. In my opinion, these borrowings point to the Near Eastern origin of the Indo-Europeans. The reality of any substrate can only be inferred from toponymy, which suggests the presence of a Neolithic pre-IE substrate, of which Basque is a remnant.¹⁴¹ Therefore, this “pre-IE substrate vocabulary of Europe” largely reflects the Near Eastern origins of Indo-Europeans.

In the Near East, primarily in Anatolia, copper was known since ca. 9000 BC, and around 5000 BC, a transition occurred from native copper to ore smelting. From 4000 BC, gold was mined and tin was smelted, used to alloy copper;

as well as silver, whose production was accompanied by the co-production of lead. Lead was sometimes alloyed with tin to prevent the so-called “tin pest”. Thus, we see a clear connection between these metals, reflected in the IE vocabulary. A unified terminology (with the exception of Anatolian) is found only for copper. The names of other metals are similar, but the PIE unity had already started to disintegrate by the time this terminology was formed, which occurred between 4000 and 3000 BC.

The analysis of the nature of Indo-European-Near Eastern relations allows us to map the possible areas of the IE languages after the start of their divergence. The situation is most obvious with Hittite, whose location in Central Anatolia is well known, as are the locations of other Anatolian languages west of the Hittite area. Their terms for copper and gold developed from a base derived from PIE, but they differ from the terminology of other Indo-European groups. This is consistent with the hypothesis that the separation of Anatolian occurred as a result of migration to the northeast of the Balkan Peninsula around 5000 BC (where copper and gold metallurgy soon emerged) and a return to the north and east of Asia Minor at the end of the 4th millennium BC. In the 18th century BC, the Hittites came from Kuššara to Kaneš and then Hattusa in Central Anatolia. It is likely that contacts with traders from Aššur were established in Kaneš, resulting in the appearance of a word for bronze in their language, equivalent to the Akkadian word for gold. At the same time, some Hattian terms were adopted, as the Hattians inhabited the center of Asia Minor.

It is also indicative that the names for gold in Sumerian and Akkadian differ from those in the IE languages, although parallels are found in the names for copper. This is explained by the fact that gold appeared in Southern Mesopotamia earlier than in Anatolia. The situation with copper is diametrically opposed.

The Greek terminology for copper (κύανος, χαλκός) has both Hittite and Hattian parallels, but was borrowed from Anatolian. This means that the Greeks were in contact with the Hittites or Luwians in the 3rd millennium BC. Some of these Hattian and Hittite terms (*hapalki*) were borrowed from Proto-West Caucasian and later transmitted to Akkadian. The Greek word for tin, κασίτερος, is associated with the Kassites and reflects the beginning of tin supply in the 3rd millennium BC from the east through the Zagros passes (SG – the relation with the Latin and Old Church Slavonic words is less reliable, as they could have had a Greek source, but it is not excluded for Indo-Aryan). Some names for gold may have appeared in Greek as a result of later trade relations with the Semitic area, but others have Phrygian and Kartvelian parallels, confirming the localization of the Proto-Greeks in northeastern Anatolia.¹⁴²

Analysis of IE names for copper, going back to two proto-forms, **r(e)ud^h-* and **haye/os-*, shows that they developed on a PIE basis in a region where the transition from the use of native copper to ore smelting took place, since derivatives of these words are used in both meanings. The distribution of these derivatives allows us to distinguish two dialectal areas:

¹³⁹ CHERNYKH/KUZMINYKH 1989, tabl. 10.

¹⁴⁰ SCHRIJVER 2018; VAN SLUIS 2024.

¹⁴¹ VENNEMAN 1994.

¹⁴² GRIGORIEV 2023b, 24.

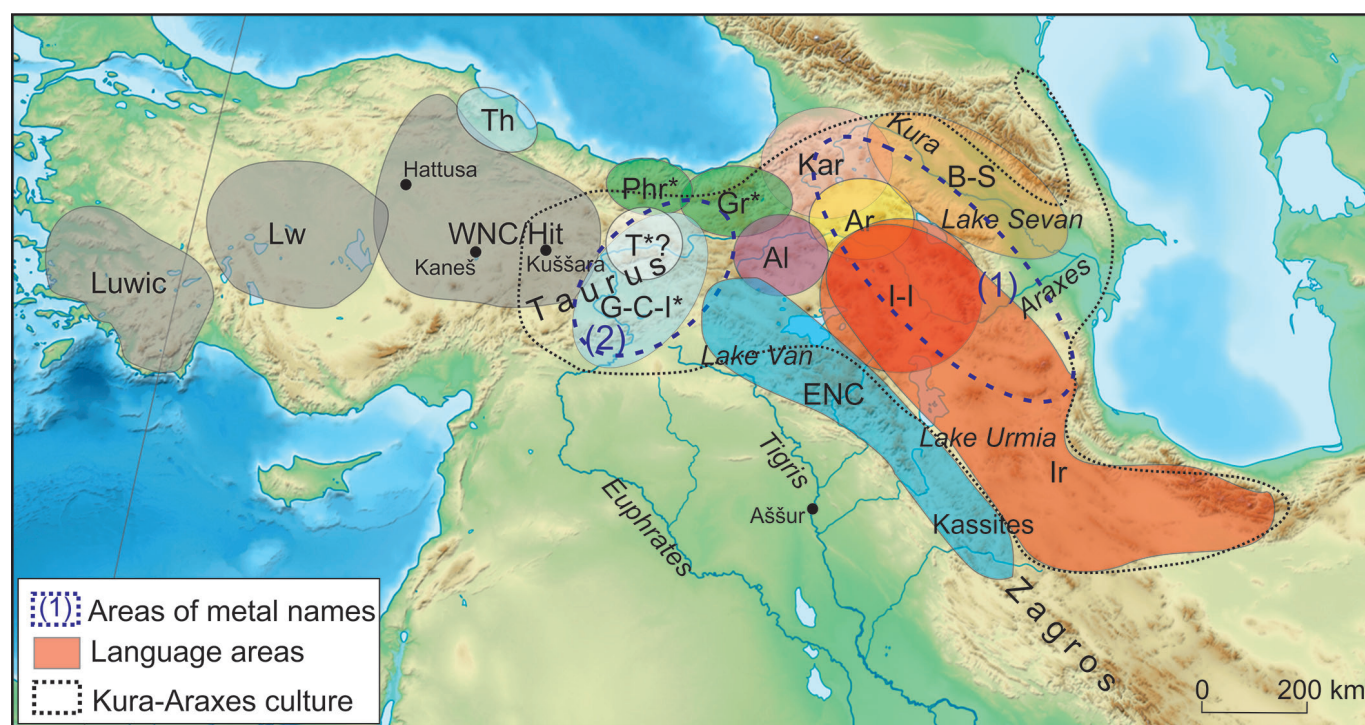


Fig. 1. Map of two areas of metal names (1) and (2), the area of the Kura-Araxes culture and the supposed areas of languages in the 3rd millennium BC (*centum* languages are marked *): Luwic (proto-Lydia, proto-Carian, proto-Lycian); Lw – Luwian and Palaic; WNC/Hit – West-Caucasian (Hattic) and Hittite; Th – Thracian; Phr* – Phrygian; Gr* – Greek; T*? – Tocharian; G-C-I* – Germanic, Celtic, Italic; Al – Albanian; Ar – Armenian; B-S – Balto-Slavic; I-I – Indo-Iranian; Ir – Iranian; Kar – Kartvelian; ENC – Eastern North Caucasian.

1) Indo-Iranian + Balto-Slavic, and 2) Proto-Germanic + Proto-Italic. Since derivatives with the *a*-prefix, characteristic of Hattic, appear in the latter area, and this form was also borrowed into Sumerian, this second area must be located in contact with the Hattic language area, in the region from which copper was supplied to southern Mesopotamia in the 3rd millennium BC. Therefore, the upper reaches of the Euphrates are the optimal choice, consistent with the parallels between the Sumerian name *urudu* ‘copper’ and the Akkadian name for the Euphrates, *Purattu*, i.e., the river where copper was smelted from ore. Proto-Celtic stands apart, as it is possible (but not definitively proven) that its word for copper, **meid-ni-*, is a borrowing from Hittite. This possibly allows Proto-Celtic to be included in the second area (Fig. 1 – the map uses a previous publication,¹⁴³ but has been modified based on this article).

The presence of these two areas is duplicated by two different terminologies for lead: 1) Balto-Slavic, and 2) Germanic-Italo-Celtic, related to Semitic. This also points to the possibility of a more southern location for the second dialectal area.

Tocharian, whose names for copper and gold are close to the Hittite ones, and the Tocharian term for tin have parallels in Germanic-Celto-Italic vocabulary, belongs to the second area. This means that at the end of the 4th and part of the 3rd millennium BC, Tocharian was still present there (Fig. 1). This is echoed by similar terminology for wheel, which differs from other IE languages: Hittite *hurki-*, Tocharian A *wärkänt*, Tocharian B *yerkwantai*, which go back to the proto-form **Hwer-gh-* ‘wheel, cart, circle’. There are also other

Tocharian-Anatolian isoglosses (e.g., Hittite *kašt-*, Tocharian A *kast* ‘famine’). It is assumed that this terminology reflects the Tocharo-Anatolian dialectal affinity before the separation of Anatolian from the Poto-Indo-European core.¹⁴⁴ However, a more probable explanation is the Hittite migration into eastern Anatolia, which could have subsequently forced the Tocharians to migrate from this region. Ultimately, at the end of the 23rd century BC, they appeared in the Zagros Mountains south of Lake Urmia, if the hypothesis that the Gutian and Tukri tribes could be related to the Tocharians is correct.¹⁴⁵ They caused many problems in southern Mesopotamia, but at the end of the 22nd century BC, they were defeated and driven to the Zagros Mountains, and then moved into Central Asia through Bactria. This route is marked by the presence in Tocharian of parallels with a ‘Central Asian substrate language’, conventionally called the “BMAC language”,¹⁴⁶ as well as an admixture of about 25% Anatolian genes in the population of the Bactria-Margiana archaeological complex.¹⁴⁷

It is easy to see that these areas correspond to two groups of IE languages: *satem* (in the Kura and Araxes basins) and *centum* (along the Upper Euphrates and to the north). The Anatolian languages located to the west were not involved in these phonetic transformations (Fig. 1).

¹⁴⁴ GAMKRELIDZE/IVANOV, 1995, 621–623.

¹⁴⁵ GAMKRELIDZE/IVANOV 1989, 29–33.

¹⁴⁶ **išti-ya* > *ištiia* ‘brick’ – Tocharian B *išcem/išcem* ‘clay’, Tocharian A: **išce: išāc*; **šec-ake* (with the Indo-Aryan suffix *(-a-ka)* > Tocharian A *šisāk*, B *šecake* ‘lion’; **anču* ‘Soma plant’ > Tocharian *ankwaš*; **tūtu-k* ‘clay’ > Tocharian loan(?) *tukri* ‘clay’; **dānu* > *dānu* ‘grain, cereal’ > Tocharian *tāno/tām*; **čūra* > *sūra* ‘hole, lacuna’ – Tocharian B *kor* ‘throat’ < IE **kuH-r/-n-* ‘hole’ (WITZEL 2015; GRIGORIEV 2025, 234–248).

¹⁴⁷ NARASIMHAN *et alii* 2019, 4.

¹⁴³ GRIGORIEV 2025b, fig. 5, 6, 8.

An additional fact is that the word for silver is common to most IE languages, and it related to the PIE word for white **hark'/*h₂erǵ-*, although it formed somewhat later than the PIE stage. A close relationship between this word and North Caucasian words, into which it was borrowed, is quite probable. In Celtic, Italic, and Albanian, the Hittite suffix *-an-* appeared in this word, indicating areal proximity and the potential inclusion of Albanian in the second dialectal area. It is also indicative that Indo-Iranian languages have a related word for silver, but without this suffix. Consequently, they must have been located to the east of this dialectal area, but close to it. For the 4th millennium BC, there is reason to localize Indo-Iranian in the region of Lakes Van, Sevan, and Urmia, which is located east of the upper reaches of the Euphrates. Derivatives of this word were later borrowed into some Finno-Ugric languages, but this happened late through the mediation of the Alanian language, when the Alans moved from Central Asia to the west of the Eurasian steppes.¹⁴⁸

Some caveats, however, are necessary. Albanian and Armenian belong to the *satem* group and should therefore be localized within the first dialectal area. However, Armenian has a number of parallels with Hittite, and Albanian with Greek, Armenian, and Indo-Aryan. On the other hand, Albanian has been significantly influenced by ancient European dialects, presumably later in the Balkans.¹⁴⁹ However, it is possible that these lexical features developed in Western Asia, and that the speakers of these two languages lived on the border of these two dialectal areas (Fig. 1).

Balto-Slavic and Germanic languages share a different vocabulary for silver (Prussian *silapris*, Russian *serebro*, Proto-Germanic **silubra-*, etc.), which has parallels in Georgian-Zan and Semitic. This means that it developed in the Near East, possibly near the Kartvelian area (Fig. 1). The Proto-Kartvelian area was located in the northeast of modern-day Turkey, from where, during the Georgian-Zan stage, it began to spread into Transcaucasia.¹⁵⁰ In this case, the Germanic variants may be borrowings from a Baltic form (probably West Baltic, close to Old Prussian). The presence of Georgian-Zan parallels in Balto-Slavic suggests that the Balto-Slavic area was located in the north, in Transcaucasia, which corresponds to the absence of Hittite-Hattic parallels, as well as some differences with the vocabulary of the second area. Tin could have reached Transcaucasia from Anatolia via the Kartvelian area, which explains the possibility of a word being borrowed into Balto-Slavic from Kartvelian. This is not contradicted by linguistic parallels in Indo-Iranian languages, whose homeland can be located in the region of Lakes Urmia, Van, and Sevan, as well as other linguistic relations between Balto-Slavic and Georgian-Zan.¹⁵¹

¹⁴⁸ GRIGORIEV 2025b, 38–40, 506–507.

¹⁴⁹ GAMKRELIDZE/IVANOV, 1995, 805–808.

¹⁵⁰ GAVASHELISHVILI *et alii* 2023.

¹⁵¹ In the linguistic literature, attention has already been drawn to the fact that, despite the abundance of IE-Kartvelian parallels, the Balto-Slavic forms are very close. “The closest are the Baltic ones, but they could not be the prototype of Kartvelian forms”. These parallels were rejected for the reason that “a direct relation with the latter cannot be considered” (KLIMOV 1994, 92, 102, 111, 114, 139, 163, 169, 173–176, 178, 180, 187, 189, 204). However, this interpretation is caused by reliance on the Steppe Theory of the IE origin, and not on the linguistic material itself. These parallels are

All these areas correspond to the area of the Kura-Araxes culture (Fig. 1). In its early stages, it was quite homogeneous, but with the expansion of its area around 3000 BC, regional differences began to form, which become pronounced in the Kura-Araxes III stage (ca. 2700–2300 BC). The most obvious are several main areas, distinguished by differences in ceramic styles: Armenian, Shida Kartli, Kvemo-Kartli (spreading into northwestern Iran, although regional features quickly developed there). In the south-west there is so called “Upper Euphrates style”, closely tied with Central Anatolia and Southern Mesopotamia, primarily with the Uruk tradition.¹⁵² All this allows us to associate the beginning of the Balto-Slavic language’s development with the Kvemo-Kartli area (confirmed by loanwords in Kartvelian), and related sites in Iran with the Indo-Iranian area. The sites with the “Armenian style” on the Upper Euphrates (to the north of the “Upper Euphrates style”) correspond to the development of Proto-Celtic, Proto-Germanic, and Proto-Italic. The connections of these languages with Hattic and Sumerian are consistent with this. The “Armenian style” area corresponds also to the formation of the Armenian, Albanian and, perhaps, Greek linguistic areas.

The borrowing of the word for silver from Balto-Slavic to Germanic could have occurred during their common migrations from the Near East through Iran, Central Asia, Siberia, and the forest-steppe and forest zones of Eastern Europe. This route is marked by the replacement of the word for gold in these languages with a word related to color, as occurred in the Indo-Iranian languages. However, it is highly likely that a parallel form, derived from PIE, existed, because **ausas* is reconstructed for Proto-Baltic. However, it was gradually replaced. The same can be said of Proto-Celtic, with its possible word **aus-*.

The subsequent migration is marked by the borrowing of words for tin and silver from Germanic into Sami, which is explained by the presence of the Seima-Turbino tradition in northern Eastern Europe and Finland. On the other hand, the word for tin was borrowed from Germanic into Balto-Slavic, and later from the latter into the Finno-Ugric languages.

The tin bronze tradition spread across Northern Eurasia with the migration of the Seima-Turbino tribes from the Altai in the early 2nd millennium BC, but they were soon replaced by the Fyodorovka (Andronovo) tribes, who continued the migration in the same direction. The latter interacted more actively with the forest tribes, which explains this sequence of lexical borrowings. It is also indicative that this vocabulary reflects the association of tin with lead, as well as the meaning of ‘pale yellow’, which is explained by the addition of lead to tin, as well as the trade of bronze ingots with a higher tin content. This was necessary to solve the problem of tin’s transition to its α -phase and its transformation into powder in the low temperatures of Northern Eurasia. However, these technologies could only have emerged in a region where copper, tin, and lead, a by-product of silver

not presented in this article, since they are not related to metallurgical vocabulary.

¹⁵² SAGONA 1984, map D; ROTHMAN 2014, fig. 2; PALUMBI/CHATAIGNER 2014, 254–255.

smelting, were simultaneously produced. The only region of the world where this combination existed in the 4th and 3rd millennia BC was southeastern Anatolia, but there, alloying tin with lead was limited due to climatic factors. After the mid-2nd millennium BC, these technologies spread widely to Europe, although an earlier penetration from Asia Minor cannot be ruled out. The spread of this technology to China, along with the corresponding Proto-Germanic word for tin, is also significant. This coincides with the appearance of derivatives of the Seima-Turbino bronzes there.

Another sign of this migration route is the development of a new vocabulary related to the concept of 'melting/boiling' in the previous Balto-Slavic area, or at the beginning of the migration process. It is borrowed into Finno-Ugric languages, including those located east of the Urals. However, later, the Celtic word for copper, possibly related to a Hittite prototype, was borrowed into Slavic languages. This occurred in Central Europe after the mid-13th century BC. Interestingly, Celtic and Italic terms provide no evidence for migration via this route, with the exception of the possible comparison of Old Chinese **lon-tos/-tus* and Latin *lentus*. However, in other vocabulary, the presence of speakers of Proto-Celtic and Proto-Italic dialects in the east is established.¹⁵³

CONCLUSION

Thus, the IE metal names have Near Eastern origins. Moreover, their analysis allows us to identify the different areas where the specific names were adopted by different IE groups, which correspond to different ceramic styles of the Kura-Araxes culture. The adoption of this terminology into Finno-Ugric and Chinese languages suggests the route of northwestern Indo-Europeans through southern Central Asia and Siberia to Europe, as once proposed by T.V. Gamkrelidze and V.V. Ivanov. Significantly, the reconstructed routes of these migrations strictly correspond to technological transformations and changes in metallurgical vocabulary. The hypothesis of the IE homeland in the steppes of Eastern Europe cannot explain the facts presented in this article. Taking into account the IE agricultural terminology, including that related to plowing,¹⁵⁴ which is bashfully omitted, the position of the Steppe Theory becomes very shaky.

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¹⁵³ GAMKRELIDZE/IVANOV 1995, 464, 468, 471-472; HYLLESTED 2010, 123-124; HYLLESTED 2016, 191-193; WEISS 2018, 377-378.

¹⁵⁴ GAMKRELIDZE/IVANOV 1995, 557-571, 593-600.

REFERENCES

- ANTHONY 2007
Anthony, D.W., *The horse, the wheel and language* (Princeton: University Press).
- BENGTSON 2004
Bengtson, J. D., Some features of Dene-Caucasian phonology (with special reference to Basque), *Cahiers de l'Institut de Linguistique de Louvain (CILL)* 30/4, 33-54.
- BLAŽEK 2015
Blažek, V., Irano-Slavica – k khronologii starykh iranskikh zaimstvovaniy v slavyanskikh yazykakh [Irano-Slavica – to the chronology of old Iranian borrowings in Slavic languages], *Trudy instituta russkogo yazyka im. V. V. Vinogradova* [Proceedings of the V. V. Vinogradov Institute of the Russian Language] 4, 70-100.
- BLAŽEK 2017
Blažek, V., Indo-European "Gold" in Time and Space, *Journal of Indo-European Studies* 45/3 & 4, 267-311.
- BLAŽEK/SCHWARZ 2016
Blažek, V./Schwarz, M., *The early Indo-Europeans in Central Asia and China. Cultural relations as reflected in language* / *Innsbrucker Beiträge zur Kulturwissenschaft*. Bd. 13 (Innsbruck: Wolfgang Meid).
- CHERNYKH 2007.
Chernykh, E. N., *Kargaly*, Vol. V (Moscow: Yazyki slavyanskoj kul'tury).
- CHERNYKH/KUZMINYKH 1989
Chernykh, E. N./Kuzminykh S. V., *Ancient metallurgy of Northern Eurasia* [*Drevnyaya metallurgiya severnoj Evrazii*] (Moscow: Nauka).
- CHUKHROV 1960
Chukhrov, F. N. (ed.), *Mineraly. Spravochnik* [Minerals. Handbook]. Vol. I (Moscow: Nauka).
- DEGTYAREVA/GRUSHIN/SHAYKHUTDINOV 2010
Degtyareva, A. D./Grushin, S. P./Shaykhutdinov, V. M., *Metalloobrabotka naseleniya eluninskoj kul'tury Verkhnej Obi (predvaritel'nye rezul'taty metallograficheskogo issledovaniya)* [Metalworking of the population of the Elunino culture of the Upper Ob (preliminary results of a metallographic study)], *Vestnik arheologii, antropologii i etnografii* [Bulletin of Archaeology, Anthropology and Ethnography] 2 (13), 27-35.
- DEGTYAREVA 2015
Degtyareva, A. D., *Slitki tsvetnogo metalla petrovskoj kul'tury (sostav i tekhnologiya polucheniya)* [Non-ferrous metal ingots of the Petrovka culture (composition and technology)], *Vestnik arheologii, antropologii i etnografii* [Bulletin of Archaeology, Anthropology and Ethnography], 2 (29), 38-50.
- DEGTYAREVA 2024
Degtyareva, A. D., *Tekhnologiya izgotovleniya mednykh i bronzovykh orudij truda petrovskoj kul'tury Yuzhnogo Zaural'ya i Srednego Pritobol'ya* [Technology of manufacturing copper and bronze tools of the Petrovka culture of the Southern Transurals and Middle Tobol region], *Vestnik arheologii, antropologii i etnografii* [Bulletin of Archaeology, Anthropology and Ethnography], 4 (67), 5-18.
- DEGTYAREVA et alii 2025
Degtyareva, A. D./Kuzminykh, S. V./Orlovskaya, L. B./Blinov, I. A./Chemyakin, Yu. P./Pilkina, A. A., *Metall alaku'skoj kul'tury Yuzhnogo Zaural'ya: morfologicheskaya*

- i khimiko-metallurgicheskaya kharakteristika [Metal of the Alakul culture of the Southern Transurals: morphological and chemico-metallurgical characteristics], *Vestnik arheologii, antropologii i etnografii* [Bulletin of Archaeology, Anthropology and Ethnography], 4 (71), 35–50.
- ELIZARENKOVA 2004
Elizarenkova, T. Ya., Sanskrit. In: Elizarenkova, T. Ya./Kibrik, A. A./ Kulikov, L. I. (eds.), *Yazyki mira: Indoarijskie yazyki drevnego i srednego periodov* [Languages of the World: Indo-Aryan Languages of the Ancient and Middle Periods] (Moscow: Academia), 25–69.
- EROL 2019
Erol, H., Old Assyrian metal trade, its volume and interactions, *Belleten* 83 (298), 779–806.
- FAYZULLIN 2020
Fayzullin, A. A., Ukrasheniya v pogrebal'noj obryadnosti nositelej yamnoj kul'tury Volgo-Ural'ya kak marker sotsial'noj znachimosti v obshchestve kochevnikov epokhi bronzy [Ornaments in the burial rituals of the Yamnaya culture of the Volga-Ural region as a marker of social significance in the society of nomads of the Bronze Age], *Povolzhskaya arkheologiya* [The Volga River Region Archaeology] 3 (33), 100–115.
- GAMKRELIDZE/IVANOV 1989
Gamkrelidze, T. V./Ivanov, V. V., Pervye indoevropejtsy v istorii: predki tokhar v drevnej Perednej Azii [The first Indo-Europeans in history: the ancestors of the Tocharians in ancient Western Asia], *Vestnik drevnej istorii* [Journal of Ancient History] 1, 14–39.
- GAMKRELIDZE/IVANOV 1995
Gamkrelidze, T. V./Ivanov, V. V., *Indo-European and the Indo-Europeans: A Reconstruction and Historical Analysis of a Proto-Language and Proto-Culture* (Berlin: Moutin de Gruyter).
- GAVASHELISHVILI et alii 2023
Gavashelishvili, A./Chukhua, M./Sakhltkhutsishvili, K./Koptekin, D./Somel, M. The time and place of origin of South Caucasian languages: insights into past human societies, ecosystems and human population genetics, *Scientific Reports*. 13:21133. <https://doi.org/10.1038/s41598-023-45500-w>.
- GRIGORIEV 2002
Grigoriev, S. A., *Ancient Indo-Europeans* (Chelyabinsk: Rifei).
- GRIGORIEV 2015
Grigoriev, S., *Metallurgical Production in Northern Eurasia in the Bronze Age* (Oxford: Archaeopress).
- GRIGORIEV 2018
Grigoriev, S. A., Social processes in ancient Europe and changes in the use of ore and alloys in metallurgical production, *Archaeoastronomy and Ancient Technologies* 6 (2), 1–30.
- GRIGORIEV 2022a
Grigoriev, S. A., Cultural genesis and ethnic processes in Central and Eastern Europe in the 3rd millennium bc: Yamnaya, Corded Ware, Fatyanovo and Abashevo cultures, *Journal of ancient history and archaeology* 9.3, 43–84.
- GRIGORIEV 2022b
Grigoriev S. A., Origins of the Greeks and Greek dialects. *Journal of ancient history and archaeology* 9.1, 5–46.
- GRIGORIEV 2023a
Grigoriev, S., Origins and migrations of the Thracians, *Journal of Ancient History and Archaeology* 10/3, 5–29.
- GRIGORIEV 2023b
Grigoriev, S. A., Indo-Europeans in ancient Anatolia, *Journal of Ancient History and Archaeology* 10/4, 5–31.
- GRIGORIEV 2025a
Grigoriev, S. A., *Indo-Aryans in the Bronze Age* (Bicester, Oxfordshire: Archaeopress).
- GRIGORIEV 2025b
Grigoriev, S. A., *Proiskhozhdenie i migratsii irantsev* [Origins and migrations of the Iranians] (Chelyabinsk: Chelyabinsk University).
- GUSEYNOV/MUGUMOVA 2017
Guseynov, G.-R. A.-K./Mugumova, A. L., Eshche raz ob indoevropeizatsii Kavkaza (po dannym lingvistiki) [Once again on the Indo-Europeanization of the Caucasus (based on linguistic data)], *Indoevropejskoe yazykoznanie i klassicheskaya filologiya* [Indo-European linguistics and classical philology] XXI, 185–193.
- HAUPTMANN et alii 2018
Hauptmann, A./Klein, S./Paoletti, P./Zettler, R. L./Jansen, M., Types of Gold, Types of Silver: The Composition of Precious Metal Artifacts Found in the Royal Tombs of Ur, Mesopotamia, *Zeitschrift für Assyriologie* 108 (1), 100–131.
- HEGGARTY et alii 2023.
Heggarty, P. et al. Language trees with sampled ancestors support a hybrid model for the origin of Indo-European languages, *Science* 381/414, 1–11.
- HONKOLA et alii 2013
Honkola, T./Vesakoski, O./Korhonen, K./Lehtinen, J./Syrjänen, K./Wahlberg, N., Cultural and climatic changes shape the evolutionary history of the Uralic languages, *Journal of evolutionary biology* 26, 1244–1253.
- HYLLESTED 2010
Hyllested, A., The precursors of Celtic and Germanic. In: Jamison, S. W./Melchert, H. C./Vine, B. H./Mercado, A. (eds.), *Proceedings of the 21st Annual UCLA Indo-European Conference: Los Angeles, October 30th and 31st, 2009* (Bremen: Hempen), 107–128.
- HYLLESTED 2016
Hyllested, A., Again on pigs in ancient Europe: the Fennic connection. In: Hansen, B. S. S./Whitehead, B. N./Olander, Th./Olsen, B. A. (eds.), *Etymology and the European Lexicon. Proceedings of the 14th Fachtagung der Indogermanischen Gesellschaft, 17–22 September 2012, Copenhagen* (Wiesbaden: Reichert Verlag), 183–196.
- IVANOV 1977
Ivanov, V. V., O proiskhozhdenii nekotorykh baltijskikh nazvanij metallov [On the origin of some Baltic names of metals], *Baltistica* 13 (1), 223–236.
- IVANOV 1983
Ivanov, V. V., *Istoriya slavyanskikh i balkanskikh nazvanij metallov* [History of Slavic and Balkan names of metals] (Moscow: Nauka).
- IVANOV 1989
Ivanov, V. V., K etimologiyam nazvanij metallov [On the etymologies of metal names]. In: Varbot, Zh. Zh./Gindin, L. A./Klimov, G. A./Merkulova, V. A./Toporov, V. N./Trubachov, O. N. (eds.), *Etimologia 1986–1987* (Moscow: Nauka), 239.
- JANSEN/BENATI 2020
Jansen, M./Benati, G., On the Beginnings of Gold Use in Southern Mesopotamia: the Rediscovery of an Artifact from the al-'Ubaid Stratum at Ur in the Collections of the Penn Museum. In: Yalçın, H. G./Stegemeier, O. (eds.), *Metallurgica Anatolica* (Istanbul: Ege Yayinlari), 319–322.

KASYAN 2010

Kasyan, A. S., Khatetskij yazyk [Hattic language]. In: Kazanskij, N. N./Kibrik, A. A./Koryakov, Yu. B. (eds.), *Yazyki mira: Drevnie reliktovyje yazyki Perednej Azii* [Languages of the World: Ancient Relic Languages of Western Asia] (Moscow: Academia), 168–183.

KERT 1966

Kert, G. M., Saamskij yazyk [Sami language]. In: Vinogradov, V. V. et alii (eds.), *Yazyki narodov SSSR. T. III. Finno-ugorskie i samodijskie yazyki* [Languages of the Peoples of the USSR. Vol. III. Finno-Ugric and Samoyedic Languages] (Moscow: Nauka), 155–171.

KLIMOV 1994

Klimov, G. A., *Drevnejšie indoevropeizmy kartvel'skikh yazykov* [The oldest Indo-Europeanisms of the Kartvelian languages] (Moscow: Nasledie).

KORENEVSKIY 2003

Korenevskiy, S. N., Metallichesкая posuda majkopsko-novosvobodnenskoj obshchnosti [Metal ware of the Maikop-Novosvobodnaya community], *Amirani* III, 7–27.

KRAUSE 2003

Krause, R. *Studien zur kupfer- und frühbronzezeitlichen Metallurgie zwischen Karpatenbecken und Ostsee* (Rahden/Westf.: Marie Leidorf Verlag).

KRAUSS et alii 2017

Krauß, R./Schmid, C./Kirschenheuter, D./Abele, J.V./Slavchev, V./Weninger, B., Chronology and development of the Chalcolithic necropolis of Varna I, *Documenta Praehistorica* 44, 282–305.

KRÜGER et alii 2012

Krüger, J./Nagel, E./Nagel, S./Jantzen, D./Lampe, R./Dräger, J./Lidke, G./Mecking, O./Schüler, T./Terberger, T., Bronze Age tin rings from the Tollense valley in northeastern Germany, *Praehistorische Zeitschrift* 87/1, 29–43.

LING et alii 2014

Ling, J./Stos-Gale, Z./Grandin, L./Billström, K./Hjärthner-Holdar, E./Persson, P.-O., Moving metals II: provenancing Scandinavian Bronze Age artefacts by lead isotope and elemental analyses, *Journal of Archaeological Science* 41, 106–132.

LIU et alii 2025

Liu, S./Sun, Zh./Zhang, J./Lin, J./Chen, K./Chen, J./Cui, J./Mei, J., 50 years of bronze provenance studies: A perspective from China, *Journal of Archaeological Science* 180, 106272.

MALLORY 1989

Mallory, J. P., *In Search of the Indo-Europeans. Language, Archaeology and Myth* (London: Thames & Hudson).

MIKHAILOVA/DYBO/NORMANSKAYA 2002,

Mikhailova, T. A./Dybo, A. V./Normanskaya, Yu. V., Osnovnye tsvetooznacheniya v kel'tskikh yazykakh [Basic Color Designations in Celtic Languages], *Moskovskij lingvisticheskij zhurnal* [Moscow Linguistic Journal], 6/1, 7–53.

MUHLI 1973

Muhly, J. D., *Copper and tin. The distribution of mineral resources and the nature of the metals trade in the Bronze Age* (Hamden: Archon Books).

NAPOLSKICH 2002

Napolskich, W., Zu den ältesten Beziehungen zwischen Finno-Ugriern und zentraleuropäischen Indogermanen. In: Blokländ, R./Hasselblatt, C. (eds.), *Finno-Ugrians and Indo-*

Europeans: linguistic and literary contacts. Proceedings of the Symposium at the University of Groningen, November 22–24, 2001. Studia Fenno-Ugrica Groningana, 2 (Maastricht), 265–271.

NAPOLSKIKH 2022

Napolskikh V. V., «Paural'skoe» *waske 'metall, (? Med'); ukrashenie' i ego «derivaty» v permskikh i ugorskikh yazykakh ["Proto-Uralic" *waske 'metal, (? copper); decoration' and its "derivatives" in the Permic and Ugric languages], *Izvestiya UrFU. Seriya 2. Gumanitarnye nauki* [UrFU News. Series 2. Humanities] 24/3, 66–81.

NARASIMHAN et alii 2019

Narasimhan, V. M. et alii, The formation of human populations in South and Central Asia, *Science* 365, 999, 1–17. DOI: [10.1126/science.aat7487](https://doi.org/10.1126/science.aat7487).

NIELSEN 2014

Nielsen, E. H., A Late Bronze Age tin ingot from Sursee-Gammainseli (Kt. Luzern), *Archäologisches Korrespondenzblatt* 44, 177–193.

PALUMBI/CHATAIGNER 2014

Palumbi, G./Chataigner, C., The Kura-Araxes culture from the Caucasus to Iran, Anatolia and the Levant: between unity and diversity. A synthesis, *Paléorient* 40.2, 247–260.

POLLARD/LIU 2022

Pollard, A. M./Liu, R., The six recipes of Zhou: a new perspective on Jin (金) and Xi (锡), *Antiquity* 96 (389), 1200–1213.

POWELL et alii 2021

Powell, W./Johnson, M./Pulak, C./Yener, K. A./Mathur, R./Bankoff, H. A./Godfrey, L./Price, M./Galili, E., From peaks to ports: Insights into tin provenance, production, and distribution from adapted applications of lead isotopic analysis of the Uluburun tin ingots, *Journal of Archaeological Science* 134, 105455.

RADIOJEVIĆ et alii 2014

Radiojević, M./Rehren, Th./Kuzmanović-Cvetković, J./Jovanović, M./Northover, J. P., Why are there tin bronzes in the 5th mill BC Balkans? In: Vitesović, S./Antonović, D. (eds.), *Archaeotechnology: Studying Technology from Prehistory to the Middle Ages* (Belgrade: Prosveta), 235–256.

RAZUMOV/LASENKO 2020

Razumov, S. N./Lasenko, S. D., Drevnejshee kurgannoe zoloto Nizhnego Podnestrov'ya kak indikator mezhkul'turnykh svyazej [The oldest gold in burial mounds of the Lower Dniester region as an indicator of intercultural ties], *Rusin* 59, 21–35.

REZEPKIN 2012

Rezepkin, A. D., *Novosvobodnenskaya kul'tura (na osnove materialov mogil'nika "Klady")* [Novosvobodnaya culture (based on materials of the Klady cemetery)] (Sankt-Petersburg: Nestor-Istoria).

ROTHMAN 2014

Rothman, M. S., Kura Araxes culture areas and the late 4th and early 3rd millennia BC pottery from Veli Sevin's surveys in Malatya and Elazığ, Turkey, *Paléorient* 40.2, 37–91.

SAGONA 1984

Sagona, A., *The Caucasian Region in the Early Bronze Age* (Oxford: BAR).

SCHRIJVER 2018

Schrijver, P. C. H., Talking Neolithic: the case for Hatto-Minoan and its relationship to Sumerian. In: Kroonen, G./Mallory, J. P./Comrie, B., (eds.), *Talking Neolithic: Proceedings of the Workshop on Indo-European Origins Held*

- at the Max Planck Institute for Evolutionary Anthropology, Leipzig, December 2–3, 2013 (Washington: Institute for the Study of Man), 336–374.
- SPIVAKOVSKIY 1975
Spivakovskiy, V. B., *Analiticheskaya khimiya olova* [Analytical chemistry of tin] (Moscow: Nauka).
- STAROSTIN 1985
Starostin, S. A., Kul'turnaya leksika v obshchekavkazskom slovarnom fonde [Cultural vocabulary in the pan-Caucasian vocabulary]. In: Piotrovskij, B. B. (ed.), *Drevnyaya Anatoliya* [Ancient Anatolia] (Moscow: Nauka), 74–94.
- THORSØ *et alii* 2023
Thorsø, R./Wigman, A. M./Jakob, A. M./Palmér, A./van Sluis, P. S./Kroonen, G. J., Word mining: metal names and the Indo-European dispersal. In: Kristiansen, K./Willerslev, E. (eds.), *The Indo-European puzzle revisited* (Cambridge: Cambridge University Press), 105–126.
- VAN SLUIS 2024
van Sluis, P. S., Substrate alternations in Celtic. In: Kroonen, G. (ed.), *Sub-Indo-European Europe: Problems, Methods, Results* (Berlin, Boston: De Gruyter Mouton), 67–132.
- VANSÉVEREN 2012
Vanséveren, S., Noms de métaux dans les textes Hittite, *Anatolica* 38, 203–219.
- VENNEMANN 1994
Vennemann, Th., Linguistic Reconstruction in the Context of European Prehistory, *Transactions of the Philological Society* 92, 215–284.
- WANG *et alii* 2016
Wang, Q./Strekopytov, S./Roberts, B. W./Wilkin, N., Tin ingots from a probable Bronze Age shipwreck off the coast of Salcombe, Devon: Composition and microstructure, *Journal of Archaeological Science* 67, 80–92.
- WEISS 2018
Weiss, M. Tocharian and the West. In: Hackstein, O./Opfermann, A. (eds.), *Priscis Libentius et Liberius Novis* (Hamburg: Baar), 373–381.
- WITZEL 2015
Witzel, M., The Central Asian substrate in Old Iranian, *Mother Tongue. Journal of the Association for the Study of Language in Prehistory* XX, 149–178.
- YALÇIN 2000
Yalçin, Ü., Anfänge der Metallverwendung in Anatolien. In: Yalçin, Ü. (ed.), *Anatolian Metal I. Der Anschnitt*, Beiheft 13, 17–30.
- YALÇIN/YALÇIN 2020
Yalçin, Ü./Yalçin, H. G., An ingot fragment of tin from EBA royal tombs at Alacahöyük, Anatolia, *SDU faculty of arts and sciences journal of social sciences* 50, 233–239.