

EDN: SGYIMW  
УДК 903(571.53/.55)

## Morphogenetic Connections of the Early Bronze Age Populations from Mongolia from Craniofacial Morphology Perspective

Myagmar Erdene<sup>a</sup> and Konstantin N. Solodovnikov<sup>b\*</sup>

<sup>a</sup>*National University of Mongolia  
Ulaanbaatar, Mongolia*

<sup>b</sup>*Tyumen Scientific Centre of Siberian Branch RAS  
Tyumen, Russian Federation*

Received 13.06.2024, received in revised form 28.07.2024, accepted 08.08.2024

**Abstract.** In this paper, we present the results of the craniometric study of Afanasievo and Chemurchek (Khemtseg or Hemtseg) archaeological cultures from the territory of Mongolia. Male crania of the Afanasievo culture from the central regions of Mongolia are characterized by a proto-European complex of traits of Eastern European origin. Among the groups of the Afanasievo culture of south Siberia, they are most similar morphologically to the series of crania from the transboundary region of the southern Altai. For the first time, we analyzed the craniological materials of the Chemurchek culture from the Early Bronze Age in Western Mongolia. Our study revealed a significant morphological difference between the Chemurchek culture population and the earlier Afanasievo culture population of South Siberia and Central Asia. From an anthropological perspective, the Chemurchek culture population is characterized by Asian features. They share close similarities with the populations from the northern regions of Mongolia during the Neolithic period. Additionally, they also bear resemblance to the populations of Serovo and Glazkovo cultures from the Circumbaikal region during the Neolithic–Bronze Age periods. We have noticed a certain similarity in the physical characteristics of early Bronze Age populations from south Siberia and central Asia. This similarity may indicate a common ancestral background among these populations. The range of physical diversity among ancient populations in Mongolia encompasses the entire spectrum of variation seen in the northern part of Eurasia during the Neolithic and early Bronze Ages, concerning the main ethnic and genetic lineages of humankind.

**Keywords:** Mongolia, Eurasian Early Bronze Age, craniofacial morphology, Afanasievo culture, Chemurchek cultural phenomenon.

Research area: Theory and History of Culture and Art (Cultural Studies); Archeology.

This research received support from: State order no. FWRZ-2021–0006 (K.N. Solodovnikov), the Ministry of Education, Culture, Science and Sport of Mongolia #2018/25 and the National University of Mongolia P2020–3955 (E. Myagmar). We express our sincere gratitude to the archaeologists Kovalev A.A., Erdenebaatar D., Tishkin A.A., Turbat C. for the opportunity to study anthropological materials from their excavations, as well as for important consultations and discussion of the problems of the Eneolithic and Bronze Age of Mongolia.

Citation: Erdene M., Solodovnikov K.N. Morphogenetic connections of the early bronze age populations from Mongolia from craniofacial morphology perspective. In: *J. Sib. Fed. Univ. Humanit. Soc. Sci.*, 2024, 17(9), 1652–1665. EDN: SGYIMW



## Морфогенетические связи населения эпохи ранней бронзы Монголии по краниологическим данным

М. Эрдэнэ<sup>а</sup>, К.Н. Солодовников<sup>б</sup>

<sup>а</sup>Монгольский государственный университет  
Монголия, Улан-Батор

<sup>б</sup>Тюменский научный центр СО РАН  
Российская Федерация, Тюмень

**Аннотация.** В работе представлены результаты краниометрического исследования материалов афанасьевской и чемурчекской культур с территории Монголии. Мужские черепа афанасьевской культуры из центральных районов характеризуются протоевропеоидным комплексом признаков восточноевропейского происхождения. Среди групп афанасьевской культуры Южной Сибири они морфологически наиболее сходны с серией черепов трансграничного региона южной части Алтая. Впервые изучены краниологические материалы чемурчекской культуры эпохи ранней бронзы Западной Монголии. Выявлены большие морфологические различия с предшествующим населением афанасьевской культуры Южной Сибири и Центральной Азии. Антропологический тип людей чемурчекской культуры характеризуется монголоидными особенностями. Наиболее сходны с чемурчекским населением популяции серовской и глазковской культур неолита-бронзы Циркумбайкальского региона, а также периода неолита из северных районов Монголии. Определенную морфологическую близость также проявляют носители археологических культур ранней бронзы юга Сибири и Центральной Азии. Антропологическое разнообразие древних популяций на территории Монголии по отношению к основным расогенетическим стволам человечества очень велико, и фактически охватывает всю межпопуляционную изменчивость северной части Евразии эпох неолита и ранней бронзы.

**Ключевые слова:** Монголия, эпоха ранней бронзы Евразии, краниометрия, афанасьевская культура, чемурчекский культурный феномен.

Научная специальность: 5.10.1. Теория и история культуры, искусства; 5.6.3. Археология.

Исследование проведено в рамках госзадания FWRZ-2021–0006 (К. Н. Солодовников), проекта Министерства просвещения, культуры, науки и спорта Монголии #2018/25 и гранта Монгольского государственного университета P2020–3955 (М. Эрдэнэ). Мы выражаем искреннюю благодарность археологам Ковалеву А. А., Эрдэнэбаатару Д., Тишкину А. А. и Турбату Ц. за предоставленную возможность изучить антропологические материалы из их раскопок, а также за важные консультации и обсуждение проблем энеолита и бронзового века Монголии.

Цитирование: Эрдэнэ М., Солодовников К. Н. Морфогенетические связи населений эпохи ранней бронзы Монголии по краниологическим данным. *Журн. Сиб. федер. ун-та. Гуманитарные науки*, 2024, 17(9), 1652–1665. EDN: SGYIMW

## Introduction

On the territory of Mongolia, the Eneolithic and Early Bronze Age are represented by the Afanasievo and Chemurchek (sometimes referred to using the Mongolian Khemtseg or Hemtseg and the Chinese Qiemuerqieke or Shamirshak) archaeological cultures (Kovalev, 2011; 2017; 2022; Earliest Europeans ..., 2015; Taylor et al., 2019; et al.). The area of distribution of the Afanasievo culture from the end of the 4th – to the first half of the 3rd millennium BC covers the Altai-Sayan highlands, East Kazakhstan, Xinjiang, to the Tien Shan in the south, and up to the Khangai mountain range in Mongolia in the east (Vadetskaya et al., 2014; Kovalev 2019; Honeychurch et al., 2021). With the emergence of the Afanasievo culture in the interior regions of Asia, copper metallurgy, the kurgan tradition of burials, and ruminant pastoralism developed (Ibid; Polyakov, 2022), which is confirmed by the paleogenetic study of domestic sheep (Hermes et al., 2020). In addition, with the arrival of the Afanasievo culture deep in central Asia, a new proto-European population had spread, contrasting with the intermediate morphologically European-Asian local populations (Khokhlov et al., 2016). The Afanasievo cranial series from the Altai and the Minusinsk Basin closely resemble the craniological materials from the Eneolithic-Bronze Age of the south of Eastern Europe, territorially from the Dnieper to the Urals, and among them, remarkably similar with the Early and early Middle Bronze Age groups from the steppes and forest-steppes of the Volga-Urals (Ibid). Paleogenetic studies also have confirmed a West Eurasian origin of Afanasievo populations

and have shown that the gene pools of the Afanasievo populations, including those from the territory of Mongolia (Allentoft et al., 2015; Hollard et al., 2018; Narasimhan et al., 2019) are similar to those of the Yamnaya culture groups from the steppes of Eastern Europe (Jeong et al., 2020; Wang et al., 2021).

The origin of the Chemurchek culture from the territory of Western Mongolia, northern Xinjiang, and Eastern Kazakhstan, is controversial. According to one of the hypotheses, its formation in the western foothills of the Mongolian Altai, no later than the middle of the 3rd millennium BC, is associated with the transcontinental migration of population groups from Western Europe, initially from the territory of modern France (Kovalev, 2011; 2022). At the same time, the significant influence and chronological continuity of the vast suite of cultures such as Okunevo from Southern Siberia and the Elunin from Altai and Eastern Kazakhstan are emphasized with the Chemurchek culture (Kovalev, 2017). According to another point of view, archaeological cultures from the Early Bronze Age of the Sayan-Altai are synchronous, and closely related within a single Okunevo-Chemurchek community. This community included the territories of East Kazakhstan, Xinjiang (Qiemuerqieke culture), Mongolia (Khemtseg culture), Tuva (Chaa-Khol culture), Altai (Karakol culture), and the Minusinsk Basin (Okunevo culture) (Lazaretov, 2017). The population groups of these cultural formations are branches of a single powerful migration flow that swept the territories previously occupied by the Afanasievs at the end of the 1st half – to the middle of the

3rd millennium BC (Ibid). The anthropological structure of archaeological populations in the south of Western and Southern Siberia of this period is determined by the interaction of the migrant (western) and local (Asian) anthropological components for each of the cultural formations with intermediate European-Asian craniological characteristics. Typologically, the European component in the population structure of the Okunevo culture of Southern Siberia, the Elunin, the Krotov, and the Samus cultures from the forest-steppe and steppe Ob-Irtysh regions differs from the Afanasievo population (Solodovnikov, 2006) and possibly represents the next, relatively “rarefied” wave of ancient Europeans.

Anthropological study of the early stages of the Bronze Age in Mongolia, until recently, was limited to the study of two crania excavated at the Afanasievo burial ground Shatar-Chulu in the southwestern foothills of Khangai Mountain in central Mongolia in the 1970s. The craniometrical study of those male crania revealed their proto-European affiliation and showed their similarity with the same cultural population of the Altai Mountains and the Minusinsk Basin (Tumen, 1978; Mamonova, 1980; Alekseev et al., 1987). In anthropological publications, they are erroneously published as originating from Western Mongolia, but in fact, this burial ground is in the central regions of the country, which confirms the conclusion about the penetration of ancient Europeans deep into Central Asia. These materials formed the basis for the hypothesis about the initial European population settled in the western regions of Mongolia and the steppes along the Yenisey. They also suggest the existence of an independent center for the formation of the European anthropological features in the eastern steppe regions of Eurasia before Afanasievs (Alekseev, 1981). However, the craniological series from the pre-Afanasievo period with an intermediate Asian-European anthropological appearance discovered in the northern foothill (Dremov, 1980; 1997) and mountainous (Chikishева, 2000; 2012) regions of Altai-Sayan rejected the previously held hypothesis.

In recent years, a vast number of archaeological monuments, including burial grounds

and other sites from the Early Bronze Age, have been discovered in Mongolia as a result of an extensive archaeological survey. Excavation of burials belonging to the Afanasievo and Chemurchek cultures of the Early Bronze Age in the western region of Mongolia has yielded a new set of human remains that can be an essential source for studying the population history of this historical period. In this research, we aim to use craniological analysis to provide clarity on the anthropological structure and ethnic background of the individuals who resided in western Mongolia during the Early Bronze Age.

## Materials and methods

### *Cranial materials used in the present study*

In this research, we examined human skeletal remains of Afanasievo and Chemurchek cultures from Early Bronze Age burials found in western and central Mongolia. These remains are currently stored in the Laboratory of Bioarchaeology at the National University of Mongolia, as well as in the Institute of Archaeology at the Mongolian Academy of Sciences. The materials were excavated by Mongolian and Russian archaeologists (Volkov V. V., Kovalev A. A., Erdenebaatar D., Tishkin A. A., Turbat C.) in different years.

The materials from the Afanasievo culture utilized in this study include crania from the Shatar-Chulu site in the Khangai mountains, central Mongolia, and Khuurai gobi (Kurgak gobi) site in the Altai Highlands, western Mongolia.

The crania of two individuals excavated from graves 2 and 3 at the Shatar-Chulu site had been measured and published previously by several researchers (Tumen, 1978; Mamonova, 1980; Alekseev et al., 1987). However, there were significant variations in the craniometric measurements and averages published by different authors. Therefore, the two male crania were re-examined at the Laboratory of Bioarchaeology, National University of Mongolia to get a more accurate assessment. It was found that the variations in observations were due to slight differences in methodology, inaccuracies in measurement scales, and some damage to the skeletal material. Some skull fragments

were lost, which contributed to these discrepancies. Therefore, the average size of the male crania found at the Shatar-Chulu burial ground of Afanasievo, should be viewed as conventional, taking into account these factors and measurements reported in previous studies.

Two crania – an adult male and young child (~6 year old), found from the Kurgan 1 at Khuurai gobi (Kurgak gobi) in the Altai Highlands were also examined in this study. These crania were included in the Southern Altai Afanasyev series.

The Chemurchek culture series from western Mongolia includes cranial materials of medium preservation from the burial grounds of Khul Uul, Khundii Gobi, Khurgan Gobi, kurg. 2 (Kovalev and Erdenebaatar, 2014a), Khulagash, Bayan-Ulgi aimag (Kovalev et al., 2020), and poorly preserved materials from the burials of Yagshiin hodoo, Kheviin am, Buural haryn ar and Khukh uzuuriin duguy, Khovd aimag (Kovalev and Erdenebaatar, 2014b; Solodovnikov et al., 2019). More materials of the Chemurchek culture, mostly of poor preservation, come from the burial grounds of Khuurai salaany am, Ulaan khudag I and Polygon I in Khovd aimag (Earliest Europeans ..., 2015). An incomplete cranium of good preservation comes from a burial in a typical Chemurchek fence 1 burial ground Altan Tolgoi-2 in Bayan-Ulgii whose cultural affiliation, however, is debatable (Solodovnikov, Turbat, 2021). Thus, cranial materials come from the burials of Bulgan type, big ritual fences, and small ritual fences that represent Chemurchek cultural phenomenon on the territory of western Mongolia (Fig. 1 of Kovalev, 2022).

We also examined a cranium from fence 31 at the Takhilgat udzuur-5 burial site in Bayan-Ulgi aimag in western Mongolia whose culture is still disputable (Solodovnikov and Turbat, 2021). The excavation's author attributed it to the Afanasievo culture, similar to the burial of a woman in a comparable rectangular enclosure near the Altan Tolgoi-2 burial site (Solodovnikov and Turbat, 2021; Fig. 3). In addition to the typical Chemurchek burial tradition with a rectangular fence oriented in the latitudinal direction, they share close radiocarbon dates that correspond to the end of the

Afanasiovo and the beginning of the Chemurchek (Hemtseg) tradition, as per the Bayesian model developed based on radiocarbon data of the Bronze Age cultures of Mongolia (Taylor et al., 2019). However, doubts have been raised about the cultural affiliation of this burial, as its archaeological investigation has not yet been completed (Kovalev et al., 2020).

Craniometric data from published and unpublished cranial series from the northern Eurasian steppe used for comparative analysis with craniological materials from Mongolia are given in Table 1. The geographical location of the Early Bronze Age cranial materials from the territory of Mongolia investigated for the present study and cranial series from the northern Eurasian steppe used for comparative analysis are marked on the map (Fig. 1).

### Methods

The cranial materials are first reconstructed with a special thermoplastic mastic based on beeswax. Then, they are examined using the craniometric method of R. Martin, modified by V.P. Alekseev and G.F. Debets (1964). Based on the craniometric measurements, we calculated the facial skeleton profile (FSP index), the preauricular facio-cerebral index (PFC index), and the Estimated Rate of the Mongoloid Component (CSME,%) (Debets, 1968).

An intragroup statistical analysis was conducted using Principal Component Analysis (with the use of STATISTICA 10.0 software) and an intergroup comparison of craniological series was carried out using canonical analysis with an averaged matrix of intragroup correlations (Yu.K. Chistov's author's program). We also used clusterisation of the Mahalanobis-Rao  $D^2$  distance using Ward's method.

### Results

#### *Craniometric measurements*

#### *of human remains from the Early Bronze Age of Mongolia*

The morphological characteristics of crania from the burials of the Afanasievo culture from central Mongolia generally correspond to those in earlier publications (Tumen, 1978; Mamonova, 1980; Alekseev et al., 1987). Male crania are very long, wide, and tall, dolichocra-



nial by the transverse-longitudinal (cephalic) index, very massive even compared to the Afanasievo craniological materials of Southern Siberia. The frontal bone has a strong external relief and is wide and moderately sloping. The face is orthognathic, very wide, and at the same time, has a small value of the upper face height, which is emphasized by the wide, very low orbits in both absolute and relative values. The horizontal profile at the upper level is within large categories of naso-malar angle values, and medium at the *subspinale* point level. The nose is short, quite broad, has a very high nose bridge, and protrudes very strongly towards the line of the general facial profile (Table 2). The anthropological type of the cranium from Shatar-Chulu is strongly European, despite a not very strong facial horizontal profile at the middle level, which can be considered as the manifestation of individual variability (Fig. 2). According to the G. F. Debets method (Debets, 1968), the average of the Facial skeleton profile index (FSP index) is 1.7, and the value of the Preauricular facio-cerebral index (PFC index) is 89.0, which defines the Estimated Rate of the Mongoloid Component (CSME) with a marked negative value of  $-29.2$ , that should be regarded as its absolute absence.

The male cranium from the Khuurai Gobi burial ground in the Altai highlands, included in the South Altai Afanasievo series, is characterized by morphological features that stand out among the craniological materials from the Eneolithic-Early Bronze Age of the Altai Mountains, and the Afanasievo culture from the Minusinsk Basin and central Mongolia. This cranium was measured by D. Tumen, unfortunately, traits that distinguish European and Asian anthropological groups and characterize the degree of facial flatness in the horizontal plane and the profiling of the nose bridge and nasal bones were not measured. Judging by the available measurements (Table 2), the Afanasievo cranium from Khuurai Gobi is characterized by a complex of morphological features, which includes a large breadth and low height of the subbrachycranial and pronounced tapeinocranial braincase; a sloping forehead which is medium at the minimum frontal breadth but very wide at the cranial vault; very

wide, tall and strongly orthognathic face; narrow, medium-high and hypsiconchal orbits; very tall and wide nose with an angle of protrusion ( $29^\circ$ ) within a large category of magnitudes, but slightly protruding by the Afanasievo scale. A morphological feature, which is not typical for Europeans, has been observed on the cranium of a young child buried alongside an adult male in Kurgan 1 at the Khuurai Gobi site as well. The facial structure of this child, who was around 6 years old, exhibits the flattened horizontal appearance that is commonly found in people of Asian descent (Table 2).

Out of all the local series of the Afanasievo culture from the Altai-Sayan, the male cranium from central Mongolia is most similar to group from the most severe bioclimatic regions of high-mountain Altai (Table 2). We have combined adult crania from the burial grounds located in the southern and southeastern regions of the Altai, the Chernovaya II in Kazakhstan and Kurgan 1 at Khuurai Gobi (Kurgak Gobi) in western Mongolia into same series. These burial sites are located in intermountain valleys with dry-steppe and semi-desert landscapes and experience a dry climate with severe cold winters (Table 2). In addition to the pronounced proto-European features both series stand out due to their massiveness, very large values of cranial height, and zygomatic diameter. The estimated rate of the Asian component of the South Altai series exhibits large negative values of  $-16.2$ , with a Facial skeleton profile index (FSP) of 1.8 and a PFC index value of 91.5.

The average craniometric parameters of Chemurchek crania from western Mongolia are different from the European complex of traits (Table 2). The results show that the total male Chemurchek series is characterized by a very long, medium wide, and tall dolichocranic crania, a narrow and sloping forehead, and a wide and very tall orthognathic face. The horizontal profile of the face is weak at the upper level and moderate at the zygo-maxillary level. The orbits are wide, absolutely, and relatively medium tall, the nasal region is large, the nose bridge and nasal bones are relatively tall or medium tall at the narrowest point, and the angle of nose protrusion to the line of the general facial profile is medium. The females demonstrate a

medium height of the face, more flattened at the zygo-maxillary level, smaller sizes of orbit and nasal region, and a small angle of nose protrusion. The Chemurchek population from Western Mongolia, both males and females, show intermediate Asian-European morphological features with a predominance of Asian traits. The indicators of FSP (55.1 for men and 80.1 for women) and PFC index (97.4 and 93.2, respectively) define the Estimated Rate of the Mongoloid Component (CSME) at 75 % and 81 %, in the composition of male and female groups respectively. A visual illustration of the cranial morphology of Chemurchek people is shown in Fig. 3.

A craniological find from fence 31 at the Takhilgat udzuur-5 burial site in Bayan-Ulgii aimag, western Mongolia differs from the Chemurchek culture crania by pronounced European features. The male cranium from this kurgan displays a significant horizontal profile of the facial region, a very high nose bridge and nasal bones at the point of greatest narrowing, and a strongly protruding nose. A combination of an extremely long and high, massive dolichocranial braincase, a very wide forehead, a wide and relatively low face, and very wide, low, chameconchal orbits characterizes the cranium of Takhilgat udzuur-5 as proto-European (Table 2; Fig. 4).

These differences are clearly demonstrated by the intragroup principal component analysis carried out for the Khangai and South Altai Afanasievo, and Chemurchek materials from the western Mongolia. PCA was carried out for male and female crania, where female crania were converted to “male” following the average coefficient of sexual dimorphism (Tables 12 and 13 of Alekseev and Debets, 1964). The first principal component (PC I) contrasts the proto-European and Asian combination of traits (Table 3). The greatest loads along it fall on the length and height of the skull, the minimum frontal breadth and angle of the forehead profile, zygomatic diameter, symotic dimensions, and the angle of nose protrusion to the general facial profile, and, with opposite signs, the height of the orbits, naso-malar and zygo-maxillary angles of the horizontal profile of the facial part of the skull. The second principal

component (PC II) describes a significantly smaller proportion of intragroup variability and differentiates predominantly Afanasievo crania with individually smaller breadth of the braincase and face, smaller height of the face and nose, and a slightly more profiled facial region in the vertical and horizontal planes, and crania with the opposite combination of features (Table 3). This, in general, corresponds to the intragroup morphological variability of the Afanasievo population of the Altai (Solodovnikov, 2006). According to the results of the statistical analysis, the cranium from the Takhilgat udzuur-5 burial ground joins the Afanasievo from Ukok Plateau, Chui steppe, Naryn valley and central Mongolia, while the cranium from Altan Tolgoi-2 joins the Chemurchek from Western Mongolia (Fig. 5).

A statistical comparison of male groups of the individual craniological finds and cranial series from the Neolithic – Early Bronze Age of the northern part of Eurasia based on canonical analysis with an averaged matrix of intragroup covariance (Table 4) separates groups of Mongoloid and Europeoid anthropological features. The selected first canonical vector (CV I) separates Asian groups with a lower cranium, narrow forehead, large and horizontally simplified face with taller orbits, low nose bridge, and slightly protruding nose, and the European series with the opposite combination of features. The second canonical vector (CV II) describes a significantly smaller proportion of intragroup variation, differentiating predominantly European and intermediate craniological series. It separates brachycranial groups with a more vertical frontal bone, and dolichocranial series with a more sloping forehead (Table 4). Describing almost half of the intergroup variation, CV I differentiates the groups into the west-east morphological vector and demonstrates a very large variability of the ancient populations on the territory of Mongolia (Fig. 6). The Asian pole is occupied by craniological finds from the Neolithic period of Eastern Mongolia (a male cranium from Norovlin Uul, and a female cranium from Tamsag Bulak, whose measurements are converted to “male”). The Neolithic series from the Far East, Yakutia, the Kitoi culture of Transbaikalia, and the Upper

and Middle Angara are found morphologically close to them. The Afanasievo crania from Khangai mountain and the Early Bronze Age burial ground Takhilgat udzuur-5 of the Mongolian Altai, together with the combined series of the Afanasievo culture from the Altai-Sayan highlands, are joined with the European groups of the Yamnaya culture and related cultural and chronological types from the steppe of Eastern Europe, the obvious reason for which is migration. Close to each other anthropological characteristics of the Early Bronze Age groups in south Siberia, specifically the one from the territory of Tuva (Aimyrlyg burial ground) and the Elunin culture from the Upper Obi region, as well as even more similar to each other Eneolithic groups from the forest-steppe Tobol-Ishim (Botai, Gladunino) and the Gumugou burial ground in Xinjiang can be considered as mestizo (Kozintsev, 2021). However, taking into account the autosomal profile revealed and genetic similarity of individuals from the latter two (Zhang et al., 2021), it is also possible to consider it as a heritage of the autochthonous northern Eurasian populations, which ethnically and genetically differs from the western populations of the Eastern European steppe. The combined Chemurchek culture male series is most similar to the series morphologically intermediate between the eastern and western “poles”, representing the autochthonous population of the southern part of Siberia and central Asia. It is most similar to the groups of the Serovo and Glazkovo cultures of the late Neolithic and Bronze Age of the Angara and Olkhon region, the Neolithic of the Kuznetsk basin, the Ust-Tartas and early Krotov cultures of the Baraba forest-steppe, and Neolithic of northern Mongolia as well (Fig. 6).

According to the results of cluster analysis, the crania of the Chemurchek culture from western Mongolia and the Neolithic crania from northern Mongolia are closely related to the craniological series of the Baikal region and Yakutia. This is depicted in Fig. 7. Additionally, the subcluster that consists of Neolithic crania from Eastern Mongolia and the Far East also joins this group. They share the predominant east Eurasian morphological traits. In clustering Mahalanobis-Rao distance  $D^2$ , craniolog-

ical series with intermediate morphological traits from the territory of south and west Siberia form a separate cluster at a low taxonomic level, where the distribution of groups corresponds to the variants of the main anthropological communities of prehistoric populations from the central regions of Eurasia (Chikisheva, 2012; Solodovnikov et al., 2020, Kozintsev, 2021). Proto-European crania of the Early Bronze Age of Mongolia from Shatar-Chulu and Takhilgat udzuur-5, differ significantly from all these groups, which represents the autochthonous Asian population, and join morphologically to other series of the Afanasievo culture of southern Siberia. Together, they are placed in a western cluster, that is formed by the ancestral populations from the steppes of eastern Europe (Fig. 7).

## Discussion

According to the results of the intergroup comparison, all Afanasievo series crania from Southern Siberia and Mongolia strongly differ from the local Neolithic-Eneolithic groups by the weak expression of Asian anthropological features and are most similar to the steppe and forest-steppe populations from the territory of Eastern Europe. The morphological characteristics of the individuals from the Afanasievo Kurgan 1 of the Khuurai Gobi burial ground in the Altai highlands draw our attention. Brachycranial crania, having low braincase are found in the Afanasievo series from the Mountainous Altai (Solodovnikov, 2003; Chikisheva, 2012; Solodovnikov and Rykun, 2018), but in combination with a pronounced proto-European feature of the facial skeleton. In the case of the male cranium from Khuurai Gobi, it is not possible to characterize the horizontal profile of the face and the profiling of the nose bridge. However, the measurements of the orbits, completely uncharacteristic for the ancient Europeans, in combination with other morphological features atypical for Afanasievo, give grounds to assume the influence of the local population with non-European morphological features.

For the case of a child buried together in this twin burial, considerable facial horizontal flatness at both the upper and middle levels of the face is unusual for Europeans. The results



of the morphological analysis are confirmed by the ancient DNA (Wang et al., 2021). The genome of this male child is modeled as a mixture of the Neolithic Eastern Mongolian population and western Siberian hunter-gatherers with no evidence of Yamnaya-Afanasievo ancestry (Ibid). This corresponds with the conclusions about the differences in the ceramic vessel from the Kurgan 1 of Khuurai Gobi burial ground in shape and ornamentation, from both the Afanasievo ceramics and the vessels of similar cultural types in the territory of Xinjiang and Kazakhstan (Stepanova, Mertz, 2021), which, raises the question of the actual Afanasievo cultural affiliation of this kurgan.

The results of the intergroup comparison of craniological materials of the Chemurchek culture with the synchronous and preceding historical periods show enormous morphological differences between them and the populations of the Afanasievo culture of southern Siberia and Mongolia, which rejects the possibility of their ethno-genetic continuity. The population of the Chemurchek culture, by the available materials, is morphologically most similar to the groups of the Serovo and Glazkovo cultures of the Late Neolithic and Early Bronze Age of the Baikal region (Angara, Olkhon region, Upper Lena) and Transbaikalia. Apparent similarity is also found to the groups of the Elunin culture from the foothill-plain Altai, and the Krotov culture of the classical stage from the Sopka II burial ground in the Baraba forest-steppe. A less morphological similarity is observed to the series of Ust-Tartas and Odinoovo cultures from Baraba, from the Aimyrlyg burial ground in Tuva (in men), and from the Gumugou burial ground in Xinjiang (Solodovnikov et al., 2019). We previously noted the presence of common moments in the ethnogenesis of these groups of ancient populations from the south of western Siberia and central Asia using the combined series from the Baraba forest-steppe (Solodovnikov and Tur, 2003). The presence of a population with craniological features similar to those from Baikal region is recorded on Neolithic-Eneolithic materials from the burial grounds of Ust-Isha, Itkul, Solontsy 5 of the foothill-plain Altai (Dremov, 1980; Chikisheva, 2012), and others in the northern foothills

of the Altai-Sayan. Morphological features similar to those of the Neolithic-Bronze Age population from the Circum-Baikalia are also observed in the craniological finds from the Neolithic burial grounds of Kharuulyn Gozgor and Marzyn khutul in Northern Mongolia (Mijidorj, 2016; unpublished data of the authors). Perhaps, the greatest morphological proximity of the Chemurchek culture population to the populations from the Circum-Baikal region, and the relative proximity with the synchronous and previous groups from the south of western and southern Siberia, and central Asia could be a manifestation of a common anthropological substrate. This substrate is characterized by the features of one of the anthropological communities of the autochthonous population from the central regions of Eurasia and apparently goes back to the boreal human population (Chikisheva, 2012; Solodovnikov et al., 2020; Kozintsev, 2021).

A cranium found from of Takhilgat udzuur-5 burial site exhibits prominent European features. Morphological analogies to this cranium are found in western Eurasia, particularly, the greatest similarity is observed to the Eneolithic-Bronze Age groups from the south of Eastern Europe. This cranium is also similar to the craniological materials of the Afanasievo culture, especially those from the Altai highlands based on both the serial and individual data, in particular, from the burial ground Bertek-33. This data is in certain disagreement with the results of the paleogenetic study (Hollard et al., 2014). For the male individual buried in fence 31 Takhilgat udzuur-5, in addition to the mitochondrial haplogroup R 1b1\*, dark pigmentations of the eyes and hair were revealed by autosomal data, as well as the Y-chromosomal haplogroup Q-M242 (Ibid) initially of East Eurasian origin. This probably demonstrates the limitations of using uniparental DNA markers for ethnogenetic reconstruction.

## Conclusion

Results of the craniometric study of skeletal materials from western and central Mongolia show very high anthropological diversity of ancient populations on the territory of Mongolia, that covers the entire interpopula-

tion variability of the northern part of Eurasia from the Neolithic and Early Bronze Age. The anthropological characteristics of the archaeological cultures of the region change with historical periods, often very contrasted in terms of physical appearance. The reason for this was migration processes, which significantly influenced the anthropological composition of the populations of the early stages of the Bronze Age, at least in Western and Central Mongolia. In conclusion, we would like to note the high resolution of craniological data in identifying genetic relationships and the ethnic origin of the early Bronze Age people of Mongolia, both at the population and indi-

vidual levels of the study. Considering the exceptional complexity of the genetic formation of the Chemurchek population (Jeong et al., 2020; Wang et al., 2021), further study of its ethnic origin on new craniological materials is highly required.

#### Приложения / Applications



#### References

- Alexeev V.P. O proiskhozhdenii drevneyshego yevropeidnogo naseleniya Minusinskoy kotloviny [On the Origin of the Ancient Caucasoid Population of the Minusin Basin]. In: *Voprosy etnografii Khakassii [Issues of ethnography of Khakassia]*, Abakan, KhakNIIYaLI, 1981. 4–10.
- Alexeev V.P., Debets G.F. *Kraniometriya: Metodika antropologicheskikh issledovaniy [Cranio-metry: Research methods in anthropology]*, Moscow, Nauka, 1964. 128 p.
- Alexeev V.P., Gokhman I.I., Tumen D. Kratkiy ocherk paleoantropologii Tsentral'noy Azii (kamen-nyy vek – epokha rannego zheleza) [A Brief Outline of the Paleoanthropology of Central Asia (Stone Age to Early Iron Age)]. In: *Arkheologiya, etnografiya i antropologiya Mongolii [Archaeology, ethnography and anthropology of Mongolia]*, Novosibirsk, Nauka, 1987. 208–241.
- Allentoft M.E., Sikora M., Sjögren K.G., Rasmussen S., Rasmussen M. et al., Population genomics of Bronze Age Eurasia. In: *Nature*, 2015, 522, 167–172. DOI: 10.1038/nature14507
- Balabanova M.A. K antropologii naseleniya eneolita – ranney bronzy (po materialam mogil'nikov Volgogradskoy oblasti) [On the Anthropology of the Population of the Eneolithic – Early Bronze Age (on Materials of Burial Grounds of the Volgograd Region)]. In: *Nizhnevolzhskiy arkheologicheskiy vestnik [The Lower Volga Archaeological Bulletin]*, 2016, 15(1), 72–94.
- Chikisheva T.A. Novye dannye ob antropologicheskom sostave naseleniya Altaya v epohi neolita-bronzy [New data on the anthropological composition of the population of Altai in the Neolithic-Bronze Age]. In: *Arheologiya, etnografiya i antropologiya Evrazii [Archaeology, ethnography & anthropology of Eurasia]*, 2000, 1, 139–148.
- Chikisheva T.A. *Dinamika antropologicheskoy differenciacii naseleniya yuga Zapadnoj Sibiri v epohi neolita-rannego zheleza [Dynamics of Anthropological Differentiation of the Population of the South of Western Siberia in the Neolithic-Early Iron Ages]*. Novosibirsk, Izd-vo IAiE SO RAN, 2012. 468 p.
- Debets G.F. Opyt kraniometricheskogo opredeleniia doli mongoloidnogo komponenta v smeshannykh gruppakh naseleniia SSSR [An attempt of craniometric determination of the proportion of the Mongoloid component in the mixed population groups of the USSR]. In: *Problemy antropologii i istoricheskoi etnografii Azii [The problems of anthropology and historical ethnography of Asia]*, Moscow, Nauka, 1968. 13–22.
- Dremov V.A. Antropologicheskie materialy iz mogil'nikov Ust'-Isha i Itkul' (k voprosu o proiskhozhdenii neoliticheskogo naseleniya Verkhnego Priob'ya) [Anthropological materials from the burial grounds of Ust-Ish and Itkul (On the question of the origin of the Neolithic population in the Upper Obi region)]. In: *Paleoantropologiya Sibiri [Paleoanthropology of Siberia]*, Moscow, Nauka, 1980. 19–46.
- Dremov V.A. *Naselenie Verkhnego Priob'ya v epokhu bronzy (antropologicheskiy ocherk) [Population of the Upper Ob region in the Bronze Age (an anthropological essay)]*, Tomsk, Izd-vo TGU, 1997. 264 p.

*Drevneyshiyev yevropeytsy v serdtse Azii: chemurchekskiy kul'turnyy fenomen. Chast' II. Rezul'taty issledovaniy v tsentral'noy chasti Mongol'skogo Altaya i v istokakh Kobdo; pamyatniki Sin'tszyana i okrainnykh zemel'* [Earliest Europeans in the heart of Asia: The Chemurchek cultural phenomenon. Part II. Results of the investigation in the central part of Altai and upper Khobdo monuments in Xingjian and contiguous area]. Eds. Kovalev A. A., St. Petersburg, MISR Publ., 2015. 320 p.

Gokhman I. I. Proiskhozhdenie tsentral'noaziatskoi rasy v svete novykh antropologicheskikh materialov [The origin of the central Asian race by the new paleoanthropological materials]. In: *Issledovaniya po paleoantropologii i kraniologii SSSR [Paleoanthropological and craniological studies in USSR]*, Leningrad, Nauka, 1980. 5–34.

Gromov A. V. Proiskhozhdeniye i svyazi okunevskogo naseleniya Minusinskoy kotloviny [The origin and connections of the Okunevo population of the Minusinsk basin]. In: *Okunevskiy sbornik. Kul'tura. Iskusstvo. Antropologiya [Okunevo collection. Culture, Art, Anthropology]*, Saint-Petersburg, Petro-Rif, 1997. 301–345.

Han K. X. Anthropological examination of the graves Gumugou at the River. Kokchdarya, Xinjian. In: *Cao gu xue bao*, 1986. 3, 361–384.

Hermes T. R., Tishkin, A. A., Kosintsev, P. A., Stepanova, N. F. Krause-Kyora, B., Makarewicz, C. A. Mitochondrial DNA of domesticated sheep confirms pastoralist component of Afanasievo subsistence economy in the Altai Mountains (3300–2900 cal BC). In: *Archaeological Research in Asia*, 2020, 24, 100232. DOI: 10.1016/j.ara.2020.100232

Hollard C., Zvéni gorosky V., Keyser C., Crubézy E. et al., New genetic evidence of affinities and discontinuities between bronze age Siberian populations. In: *American Journal of Physical Anthropology*, 2018, 167(1), 97–107. DOI: 10.1002/ajpa.23607

Honeychurch W., Rogers L. Chunag A., Erdenebaatar D., Erdene-Ochir N.-O., Hall M., Hrivnyak M. The earliest herders of East Asia: Examining Afanasievo entry to Central Mongolia. In: *Archaeological Research in Asia*, 2021, 26, 100264. DOI: 10.1016/j.ara.2021.100264

Jeong C., Wang K., Wilkin S., Taylor W. T. T. et al., A dynamic 6,000-year genetic history of Eurasia's Eastern Steppe. In: *Cell*, 2020, 183(4), 890–904.e29. DOI: 10.1016/j.cell.2020.10.015

Kazarnitsky A. A. *Naseleniye azovo-kaspiyskikh stepey v epokhu bronzy: (antropologicheskii ocherk) [Population of the Azov-Caspian steppes in the Bronze Age: (anthropological essay)]*. St. Petersburg, Nauka Publ., 2012. 264 p.

Khokhlov A. A. *Morfogeneticheskiye protsessy v Volgo-Ural'ye v epokhu rannego golotsena (po kraniologicheskim materialam mezolita – bronzovogo veka [Morphogenetic processes in the Volga-Ural region in the early Holocene era (based on craniological materials of the Mesolithic – Bronze Age)]*. Samara, SGSPU Publ., 2017. 368 p.

Khokhlov A. A., Solodovnikov K. N., Rykun M. P., Kravchenko G. G., Kitov E. P. Kraniologicheskie dannye k probleme svyazi populyacij yamnoj i afanas'evskoy kul'tur Evrazii nachal'nogo etapa bronzovogo veka [Craniological data on the problem of connection between the populations of the Yamnaya and Afanasievo cultures of Eurasia at the early stage of the Bronze Age]. In: *Vestnik arheologii, antropologii i etnografii [Bulletin of archeology, anthropology, and ethnography]*, 2016, 3, 86–106. DOI: 10.20874/2071–0437–2016–34–3–086–106

Kovalev A. A. (2011). The Great Migration of the Chemurchek People from France to the Altai in the Early 3rd Millenium BCE. In: *International Journal of Eurasian Studies*, 1(11), 1–58.

Kovalev A. A. Rol' chemurchekskogo kul'turnogo fenomena v formirovani i razvitii kul'tur bronzovogo veka Sibiri i Kazakhstana [The Role of the Chemurchek Cultural Phenomenon in the Formation and Development of Bronze Age Cultures of Siberia and Kazakhstan]. In: *Trudy V (XXI) Vserossiyskogo arheologicheskogo s'yezda v Barnaule – Belokurikha [Proceedings of the V (XXI) All-Russian Archaeological Congress in Barnaul – Belokurikha]*, 1, Barnaul, Izd-vo Alt. Univers., 2017. 267–269.

Kovalev A. A. Rasprostraneniye afanas'yevskoy kul'tury na territorii Sin'tszyana: khronologicheskiye ramki i tipologicheskiye osobennosti [The spread of the Afanasievo culture in the territory of Xinjiang: chronological framework and typological features]. In: *Fenomeny kul'tur rannego bronzovogo veka step-*

*noy i lesostepnoy polosy Yevrazii: puti kul'turnogo vzaimodeystviya v V–III tys. do n.e. [Phenomena of the early Bronze Age cultures of the steppe and forest-steppe zone of Eurasia: cultural interaction ways in the 5th – 3rd millennium BC].* Orenburg, Izd-vo OGPU, 2019. 188–209.

Kovalev A. A. The Chemurchek (Qie'muerqieke) Cultural Phenomenon As a Result of Western European Migration to Dzungaria and the Mongolian Altai. In: *Cultures in Contact Central Asia as Focus of Trade, Cultural Exchange and Knowledge Transmission*. Wiesbaden, Harrassowitz Verlag, 2022. 531–554. DOI: 10.13173/9783447118804.531

Kovalev A. A., Erdenebaatar D. Issledovaniya ritual'nykh ograd chemurchekskogo oblika i svyazan'nykh s nimi pamyatnikov v Bayan-Ul'gi aymake Mongolii v 2004 g. [Investigation of the ritual fences of the Chemurchek appearance and related monuments in Bayan-Ulgi aimag, Mongolia in 2004]. In: *Drevneyshiyev yevropeytsy v serdtse Azii: chemurchekskiy kul'turnyy fenomen. CH. I: Rezul'taty issledovaniy v Vostochnom Kazakhstane, na severe i yuge Mongol'skogo Altaya [Earliest Europeans in the heart of Asia: The Chemurchek cultural phenomenon. Part I. Excavations in east Kazakhstan, North and South of Mongolian Altai]*. Petersburg, Lema Publ. St., 2014a. 163–234.

Kovalev A. A., Erdenebaatar D. Issledovaniya chemurchekskikh kurganov v Bulgan somone Khovd (Kobdoskogo) aymaka Mongolii v 2003–2010 gg. [Investigation of the Chemurchek kurgans in Bulgan soum, Khovd (Kobdo) aimag, Mongolia, in 2003–2010 yrs]. In: *Drevneyshiyev yevropeytsy v serdtse Azii: chemurchekskiy kul'turnyy fenomen. CH. I: Rezul'taty issledovaniy v Vostochnom Kazakhstane, na severe i yuge Mongol'skogo Altaya [Earliest Europeans in the heart of Asia: The Chemurchek cultural phenomenon. Part I. Excavations in east Kazakhstan, North and South of Mongolian Altai]*. St. Petersburg, Lema Publ., 2014b. 235–406.

Kovalev A. A., Solodovnikov K. N., Munkhbaya Ch., Erdene M., Nechvaloda A. I., Zubova A. V. Paleoantropologicheskoye izucheniye cherepa pogrebennogo v zakhoroneni na chemurchekskom svyatilishche Khulagash (Bayan-Ul'giyskiy aymak Mongolii) [Paleoanthropological study of the cranium from in the burial at the Chemurchek sanctuary, Hulagash (Bayan-Ulgii aimag)]. In: *Vestnik arheologii, antropologii i etnografii [Bulletin of archeology, anthropology, and ethnography]*, 2020, 1(48), 78–95. DOI: 10.20874/2071–0437–2020–48–1–8

Kozintsev A. G. Patterns in the Population History of Northern Eurasia from the Mesolithic to the Early Bronze Age, Based on Craniometry and Genetics. In: *Archaeology, ethnography & anthropology of Eurasia*, 2021, 4(49), 140–151. DOI: 10.17746/1563–0110.2021.49.4.140–151

Kruts S. I. *Paleoantropologicheskoye issledovaniya stepnogo Pridneprov'ya (epokha bronzy) [Paleoanthropological studies of the steppe Dnieper region (Bronze Age)]*. Kiev, Naukova Dumka Publ., 1984. 208 p.

Lazaretov I. P. Obshchnost' kul'tur Sayano-Altaya v epokhu ranney bronzy [Commonality of cultures of Sayano-Altai in the Early Bronze Age.]. In: *Trudy V (XXI) Vserossiyskogo arheologicheskogo s'yezda v Barnaule – Belokurikhe [Proceedings of the V (XXI) All-Russian Archaeological Congress in Barnaul – Belokurikha]*, 1, Barnaul, Izd-vo Alt. Univers., 2017. 284–289.

Mamonova N. N. Drevnee naselenie Mongolii po dannim paleoantropologii [Ancient population from Mongolia based on the paleoanthropological data]. In: *Trudy III mezhdunarodnogo kongressa mongolovedov [Proceedings of the 3rd International Congress of Mongolists]*, 3, Ulaanbaatar, 1979. 204–210.

Mamonova N. N. Antropologicheskyy tip drevnego naseleniya Zapadnoy Mongolii po antropologicheskim dannym [Anthropological type of the ancient population of Western Mongolia according to anthropological data]. In: *Issledovaniya po paleoantropologii i kraniologii SSSR [Paleoanthropological and craniological studies in USSR]*, Leningrad, Nauka, 1980. 60–74.

Mamonova N. N. K voprosu o mezhhruppovykh razlichiyakh v neolite Pribaikaliya [On the intergroup differences in the Cis-Baikal Neolithic]. In: *Voprosy antropologii [Anthropology Issues]*, 1983, 71, 88–103.

Mijidorj E. Craniological and osteological study of Neolithic human remains from Egiin Gol. In: *Mongolian Journal of Anthropology, Archaeology and Ethnology*, 2016, 1(471), 1–15.

Narasimhan V. M., Patterson N., Moorjani P., Rohland N., Bernardos R. et al., The formation of human populations in South and Central Asia. In: *Science*, 2019, 365(6457), 7487. DOI: 10.1126/science.aat7487



Poliakov A. V. (2022). *Khronologiya i kul'turogenез pamyatnikov epokhi paleometalla Minusinskikh kotlovin [Chronology and cultural genesis of the Paleometal epoch sites in Minusinsk basin]*. St. Petersburg, Institute for the History of Material Culture RAS, 364 p. DOI: 10.31600/978-5-907298-32-3

Solodovnikov K. N. Materialy k antropologii afanas'evskoy kul'tury [Materials for the anthropology of the Afanasiev culture]. In: *Drevnosti Altaya [Antiquities of Altai]*, Gorno-Altajsk, Izd-vo GASU, 2003, 10, 3–27.

Solodovnikov K. N. *Naseleniye Gornogo i lesostepnogo Altaya epokhi ranney i razvitoy bronzy po dannym paleoantropologii: dissertatsiya kandidata istoricheskikh nauk [The early and advanced Bronze Age population from the mountainous and forest-steppe Altai according to paleoanthropological data]*. Dissertation of the Ph.D in history, Barnaul, 2006. 256 p.

Solodovnikov K. N., Bagashev A. N., Savenkova T. M. Arealy antropologicheskikh obshchnostey naseleniya neolita Yuga Zapadnoy i Sredney Sibiri [Areas of anthropological communities of the neolithic population in the south of western and central Siberia]. In: *Vestnik Tomskogo gosudarstvennogo universiteta. Istoriya. [Journal of Tomsk state university. History]*, 2020, 68, 158–167. DOI: 10.17223/19988613/68/23

Solodovnikov K. N., Bagashev A. N., Tur S. S., Gromov A. V., Nechvaloda A. I., Kravchenko G. G. Istochniki po paleoantropologii neolita – eneolita Srednego Priirtysh'ya [Neolithic-Eneolithic paleoanthropological sources from the Middle Irtysh area]. In: *Vestnik arheologii, antropologii i etnografii [Bulletin of archeology, anthropology, and ethnography]*, 2019, 3(46), 116–136. DOI: 10.20874/2071-0437-2019-46-3-116-136

Solodovnikov K. N., Rykun M. P. K voprosu ob avtokhtonnom komponente v sostave naseleniya eneolita – bronzy Gornogo Altaya: materialy iz kollektsii i arkhiva kabineta antropologii Tomskogo gosuniversiteta [The autochthonous component in the composition of the Eneolithic-Bronze Age population of the Gorny Altai: Materials from the collection and archives of the Anthropology Department, Tomsk State University]. In: *Vestnik arheologii, antropologii i etnografii [Bulletin of archeology, anthropology, and ethnography]*, 2018, 1(40), 46–59. DOI: 10.20874/2071-0437-2018-40-1-046-059

Solodovnikov K. N., Tur S. S. Kraniologicheskiye materialy yeluninskoy kul'tury epokhi ranney bronzy Verkhnego Priob'ya [Craniological materials of the Elenin culture of the Early Bronze Age from the Upper Obi region], In Kiryushin Yu. F., Grushin S. P. and Tishkin A. A. In: *Pogrebal'nyy obryad naseleniya epokhi ranney bronzy Verkhnego Priob'ya (po materialam gruntovogo mogil'nika Teleutskiy Vzvoz-I) [Funeral rites of the Early Bronze Age population from the Upper Obi region (Based on materials from the soil burial ground Teleutskiy Vzvoz-I)]*. Appendix I. Barnaul, Izd-vo Alt. Univers., 2003. 142–176.

Solodovnikov K. N., Tur S. S. K antropologii neoliticheskogo naseleniya Barnaul'skogo Priob'ya (po materialam mogil'nika Firsovo XI) [On anthropology of the neolithic population of the Ob river basin Near Barnaul (basing on the materials of the burial ground of Firsovo XI)]. In: *Vestnik arheologii, antropologii i etnografii [Bulletin of archeology, anthropology, and ethnography]*, 2017, 3(38), 60–70. DOI: 10.20874/2071-0437-2017-38-3-060-072

Solodovnikov K. N., Turbat Ts. Nakhodka kraniauma cheloveka yevropeidnogo tipa iz pogrebeniya ranney bronzy v vysokogor'ye Mongol'skogo Altaya [A finding of a Caucasoid type human cranium from an Early Bronze Age burial in the highlands of the Mongolian Altai]. In: *Arkheologicheskiye pamyatniki Yuzhnoy Sibiri i Tsentral'noy Azii: ot poyavleniya pervykh skotovodov do epokhi slozheniya gosudarstvennykh obrazovaniy [Archaeological sites of Southern Siberia and Central Asia: from the appearance of the first herders to the epoch of the establishment of state formations]*. St. Petersburg, IIMK RAN, 2021. 145–148. DOI: 10.31600/978-5-907298-16-3.145-148

Solodovnikov K. N., Tumen D., Erdene M. Kraniologiya chemurchekskoy kul'tury Zapadnoy Mongolii [Craniology of Chemurchek culture from western Mongolia]. In: *Drevnosti Vostochnoy Yevropy, Tsentral'noy Azii i Yuzhnoy Sibiri v kontekste svyazey i vzaimodeystviy v yevraziyskom kul'turnom prostranstve (novyye dannyye i kontseptsii) [Antiquities of Eastern Europe, Central Asia, and Southern Siberia in the context of connections and interactions in the Eurasian cultural space (new data and concepts)]*. St. Petersburg, IIMK RAN, 2019. 79–81. DOI: 10.31600/978-5-907053-35-9-79-81



Stepanova N.F., Mertz I.V. Novoye o lokal'nykh variantakh afanas'yevskoy kul'turno-istoricheskoy obshchnosti [New local versions of Afanasievo cultural-historical community]. In: *Kul'tury Aziatskoy chasti Yevrazii v drevnosti i srednevekov'ye* [Cultures of the Asian part of Eurasia in ancient and Middle Ages]. Samarkand, Samarkand. gosudarstv. Univers., 2021. 332–337.

Taylor W., Wilkin S., Wright J., Dee M., Erdene M., Clark J., Tuvshinjargal T., Bayarsaikhan J., Fitzhugh W., Boivin N. (2019). Radiocarbon dating and cultural dynamics across Mongolia's early pastoral transition. In: *PLoS One*, 14(11), e0224241. DOI: 10.1371/journal.pone.0224241

Tumen D. Paleoantropologicheskaya nakhodka u gory Shatar-Chulu [Paleoanthropological findings at the Shatar-Chulu Mountain]. In: *Studia Archeologica*, VII, 10–18, Ulaanbaatar, 1978. 23–31.

Tumen D. *Voprosy etnogeneza mongolov v svete dannykh paleoantropologii.: dissertatsiya kandidata istoricheskikh nauk* [The problem of the ethnogenesis of Mongols from the paleoanthropological perspective]. Dissertation of the Ph.D in history. Moscow, 1985. 178 p.

Vadetskaya E.B., Polyakov A.V., Stepanova N.F. *Svod pamyatnikov afanas'yevskoy kul'tury* [Monuments of the Afanasievo culture]. Barnaul, AZBUKA, 2014. 380 p.

Wang C.-C., Yeh H.-Y., Popov A.N., Zhang H.-Q., Matsumura H. et al., Genomic insights into the formation of human populations in East Asia. In: *Nature*, 2021, 591, 413–419. DOI: 10.1038/s41586-021-03336-2

Zhang F., Ning C., Scott A., Bjørn R., Li W. et al., (2021). The genomic origins of the Bronze Age Tarim Basin mummies. In: *Nature*, 599, 256–261. DOI: 10.1038/s41586-021-04052-7