doi:10.17746/1563-0110.2023.51.1.119-126

A.A. Tishkin[1] and O.V. Orfinskaya[2]
[1]Altai State University,
Pr. Lenina 61, Barnaul, 656049, Russia
E-mail: tishkin210@mail.ru
[2]Centre for Egyptological Studies,
Russian Academy of Sciences,
Leninsky pr. 29, bldg. 8, Moscow, 119071, Russia
E-mail: orfio@yandex.ru

A Study of Silk Fabric from the Xiongnu Age Under-Headdress Discovered at Yaloman II Mound 51 in the Central Altai

We describe a large fragment of fabric from the under-headdress excavated from mound 51 at Yaloman II—a site on a high terrace near the place where the Bolshoy Yaloman flows into the Katun, Central Altai. Various criteria, including radiocarbon analysis, suggest that the burial dates to the Xiongnu Age (200 BC to 100 AD). The structure of the textile was assessed microscopically. On the basis of morphological criteria, the fibers were identified as silk. The fabric is described according to the accepted international standards. Results attest to the use of a treadle loom for producing polychrome silk fabric, from which the early nomads sewed a headdress in the form of a cap or bonnet. Such a prestigious material was produced in limited quantities in China to decorate details of clothing worn by the elite. Decorative silk items could have been imported from there to the Altai as gifts received by the leader of the nomadic Xiongnu Empire in Inner Asia. The Altai was part of this empire, as demonstrated by the entire assemblage of funerary items from Yaloman II.

Keywords: *Central Altai, Yaloman II, Xiongnu Age, early nomads, under-headdress, decorative silk fabric.*

Introduction

Excavations of the ancient necropolis of Yaloman II in the Central Altai provided a wealth of information about the material culture of the ancient nomads (Tishkin, Gorbunov, 2003; Tishkin, 2007a; Tishkin, 2011; Tishkin, Mylnikov, 2016: 43–55, fig. 7–40; and others). Analysis of the finds showed certain parallels, mainly with the collections from the Xiongnu sites in Inner Asia (Tishkin, Gorbunov, 2005; Gorbunov, Tishkin, 2006; Tishkin, 2011; and others), as well as the presence of ancient Chinese goods (Tishkin, 2006, 2007a; Novikova, Marsadolov, Tishkin, 2018; and others). These conclusions indicate that the early Bulan-Koba population (Tishkin, Gorbunov, 2006) was strongly influenced by the Xiongnu people during the period of their domination, and represented one of the groups of a large nomadic association in the Altai (Tishkin, Gorbunov, 2005: 332; Tishkin, 2007b: 176–178).

Various categories of items from the mounds of Yaloman II have already been studied and described (see References). The main objective of this article is to present the results of a comprehensive study of the fabric used for the manufacture of an under-headdress. The remaining part of this piece decorated with sewn-on plaques made of precious metal was found in mound 51 at the Yaloman II

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cemetery. The site is located on a high floodplain terrace in the Katun River valley, near the mouth of the Bolshoy Yaloman River (Ongudaisky District of the Altai Republic). The map showing its location, description, and photographs have been repeatedly published elsewhere (Tishkin, 2011; Tishkin, Mylnikov, 2016: 7–8, fig. 4–8; etc.), which allows us not to dwell on the presentation of this information.

Description of the investigated archaeological object

The above-ground burial structure of kurgan 51 was a stone-earthen mound (diameter 4.5 m, height 0.25 m), which was clearly visible among the nearby features hardly noticeable on the surface. Larger stones were placed around its foot, but did not form a clear stone circle. Under the mound, a horse was interred in a shallow grave-pit over the cover of a stone box built of massive slabs. This undisturbed burial chamber (length 1.8 m, width 1 m, height ca 0.5 m) contained the remains of a young woman (20–25 years old) and typical grave goods (Fig. 1, *1*, *2*). The finds include a copper cauldron, wooden utensils, a stone incense burner, two belts, a handbag, and ornaments. Organic remains around the skeleton suggest the presence of clothing and footwear (Tishkin, 2005). Of particular importance was a leather belt with a metal buckle in the shape of a lizard, which was produced using the ancient Chinese lacquer-coating technique (Tishkin,

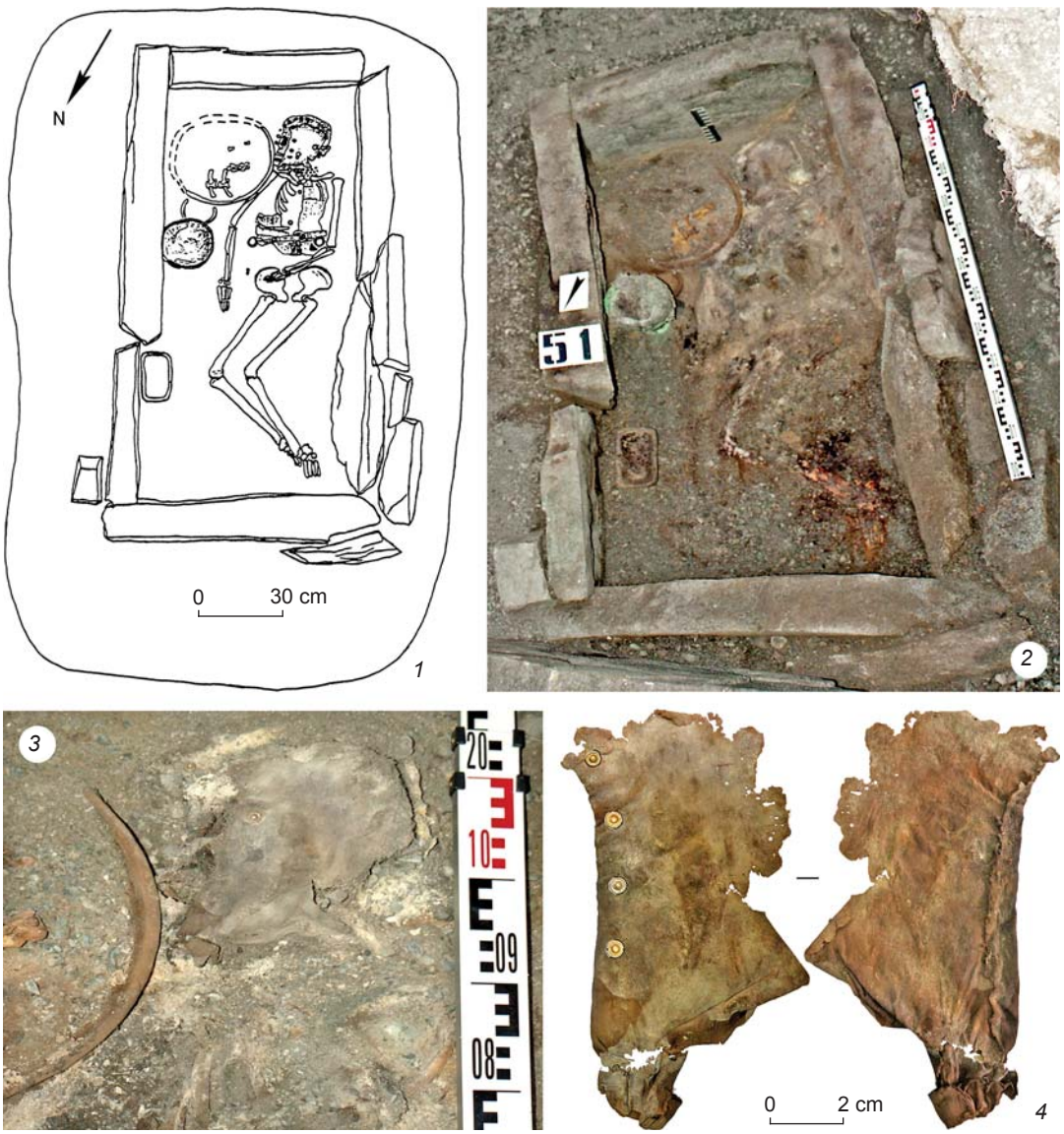

Fig. 1. Burial mound 51.
1 – map; *2* – photo; *3* – survived piece of fabric; *4* – part of under-headdress.

2011: Fig. 7; Novikova, Marsadolov, Tishkin, 2018: 114, 115, fig. 6). The bag, embroidered with beads, contained a copper bell and a small fragment of a bronze Chinese mirror (Tishkin, 2006: 111–113; Tishkin, 2011: Fig. 6, *27*; 8, *25*, *26*). The cist did not contain soil, which ensured the preservation of a part of the fabric headdress, lying *in situ* on the skull (Fig. 1, *3*). On the basis of this find, decorated with ten sewn-on plaques (Fig. 1, *1*, *4*), attempts were made to reconstruct the item, which likely represented a bonnet or a cap (Tishkin, 2005: Fig. 2; Tishkin, 2019: Fig. 1, *6*). The recorded location of the decorative sewn-on plaques made it possible to identify similar headdresses in other burials at Yaloman II and at the contemporaneous site of Ust-Edigan (Hudiakov, 2003). This confirms their broad distribution among the Altai nomads in the Xiongnu Age, along with other types of headdresses. The studies of materials of the preceding Pazyryk culture have demonstrated a completely different practice in the manufacture and use of headdresses (Polosmak, 2001: 143–162; Yatsenko, 2006: 89–94).

The piece of fabric from mound 51 is currently stored in the Museum of Archaeology and Ethnography of Altai at Altai State University (Barnaul, Russia), and in the Accession Register has catalogue number 181/563. A special study of this item was carried out by the Department of Archaeological Heritage of the Likhachev Russian Research Institute for Cultural and Natural Heritage (Russian Heritage Institute) in Moscow. The description was carried out in accordance with the accepted international standards.

Research methods, description and characteristics of fabric

The pattern of textile weaves and the type of threads in the fabric were determined through microscopic analysis in reflected natural light, using a textile Flash Magnifier (up to ×10 magnification) and a Stemi 2000-CS stereomicroscope (up to ×100 magnification). The features of fibers, as well as the degree of their contamination and damage, were determined by the microscopic analysis in transmitted polarized light, using the Olympus BX41 microscope (magnification up to ×100–400). For research, permanent immersion preparations in fir balsam were made. These were compared with reference textile fibers from the collections of the Center for Historical and Traditional Technologies of the Russian Heritage Institute. Silk fibers were identified both by morphological features and by the presence of the so-called interference color, which can be observed in transmitted polarized light (dark field).

Two fragments of the recovered fabric were analyzed (Fig. 1, *4*). Their maximum dimensions before restoration were approximately as follows: 29 × 18 cm (upper) and 4.5 × 4.5 cm (lower). Visually, the fabric is perceived as smooth and monochrome (Fig. 2, *1*). Microscopic analyses revealed that the warp threads overlap the weft threads in the 3:1 pattern, as in twill; however, in twill, the vertical shift (So) is equal to one, and in the fabric under analysis, it is two. The weave pattern on both sides is exactly the same (3:1 and 1:3). The micrograph (Fig. 2, *2*) shows that the order of change of weaves is not constant, i.e. the warp thread that overlaps one weft is located either to the right or to the left of the warp thread that overlaps three wefts. Such a phenomenon for this fabric with a high warp density can be considered normal, because it was made as double-sided material, where the main threads were arranged in pairs one under the other. With this system, the fabric should be two-colored.

The fabric could have be produced on a four-shaft weaver loom (according to the reconstruction of the European version of the loom). It is hardly possible to imagine a simpler version (without a shaft system) of producing a fabric with a density of 120–140 warp threads per 1 cm. Two equivalent schemes for threading a four-shaft loom are possible. The first variant (Fig. 2, *3*): weave pattern corresponds to a twill 2:2, with a shift of warp; the first warp thread runs along the wrong side (system 1:3), and the second along the front side (system 3:1), with the first thread "falling" under the second and being almost invisible from the front side; the third and fourth threads "behave" similarly, only mirrored and with a shift, with the fourth thread going under the third one. In the second variant (Fig. 2, *4*), such a fabric can probably be classified as one-and-a-half-layer fabric with a double warp (according to the modern Russian classification) or warp-faced compound tabby (according to the English terminology). In this system, the second and fourth threads go under the first and third ones, respectively; in the shaft system, the opening of the shed for the first and third row of the weft is ensured by raising the same shafts (Fig. 2, *5*).

In the lower (small) part of the headdress under consideration, a transverse strip is clearly visible (the same on the front and back sides along the weft threads), where the warp threads overlap not three, but five weft ones. Perhaps this was not a mistake in weaving, but a premeditated decision by the artisan (Fig. 3, *1*, *3*). Such a feature could have appeared as a result of skipping two weft rows (Fig. 3, *1*). On the large (upper) fragment, a horizontal line passes through its entire width, while on the small (lower) fragment, it runs over a small area, and then goes into the usual weave pattern of this fabric (Fig. 3, *2*). This means that two passes of the weft threads on a part of fabric do not disappear anywhere. This phenomenon can be explained only by a special decision by the artisan. Perhaps, near one of the (for example, left-side) edges (in our case, the edges are missing), to align the canvas and strengthen the edges, the weft was

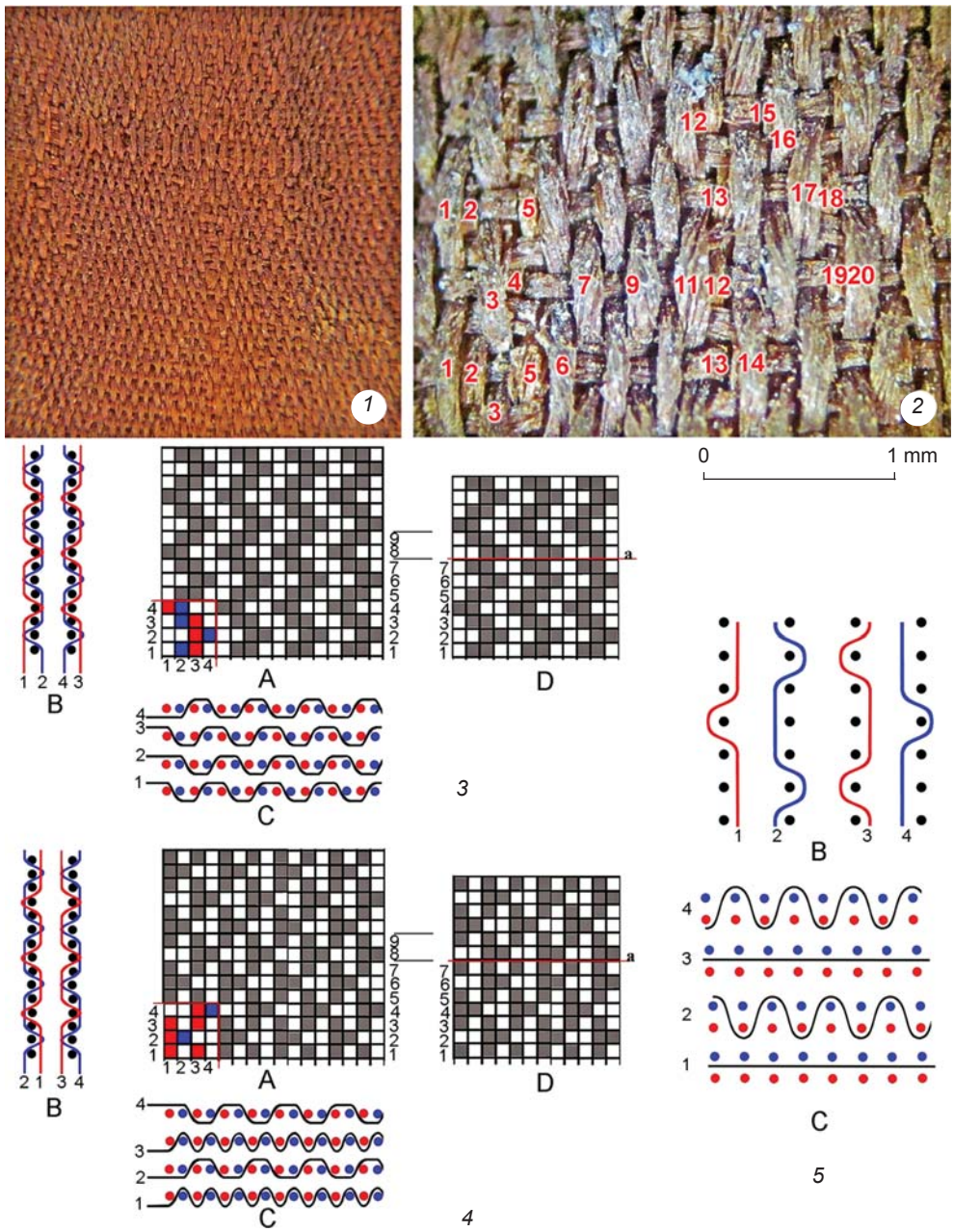

Fig. 2. The results of study of the large (upper) fragment of the fabric.
1 – micrograph of a fabric section (side of a square 1 cm); *2* – micrograph of a fragment, where the warp threads visible from one side are marked with numbers; *3* – weave pattern: twill 2:2, shifts in warp; *4* – scheme of one-and-a-half-layer fabric; *5* – a scheme of multiple plain weave with a warp cover. A – weave pattern; B – section view with the warp threads located vertically; C – section view with weft threads located horizontally; D – the pattern of weaving threads on a section of fabric with a horizontal stripe (odd warp threads are marked in red, even ones are marked in blue).

passed to a short distance from left to right (first pass), then returned back from right to left (second pass), after which the pass was made through the entire canvas. In this case, two passes are "lost" on the main part of the canvas, i.e. a visual horizontal stripe is formed. The area with the vertical strip (Fig. 3, *3*, *4*) is observed only on a small fragment. This situation is possible only if the warp threads are combined into pairs.

Throughout the canvas, there are numerous losses in the weave pattern, which can be considered as errors. However, a detailed microscopic examination showed that these were not errors, but the places of transition of the warp threads from the front side (3:1) to the wrong side (1:3) or vice versa (Fig. 4). Such a weave pattern might imply that one side of the fabric had one color, and the other side had another; the transition of colored warp

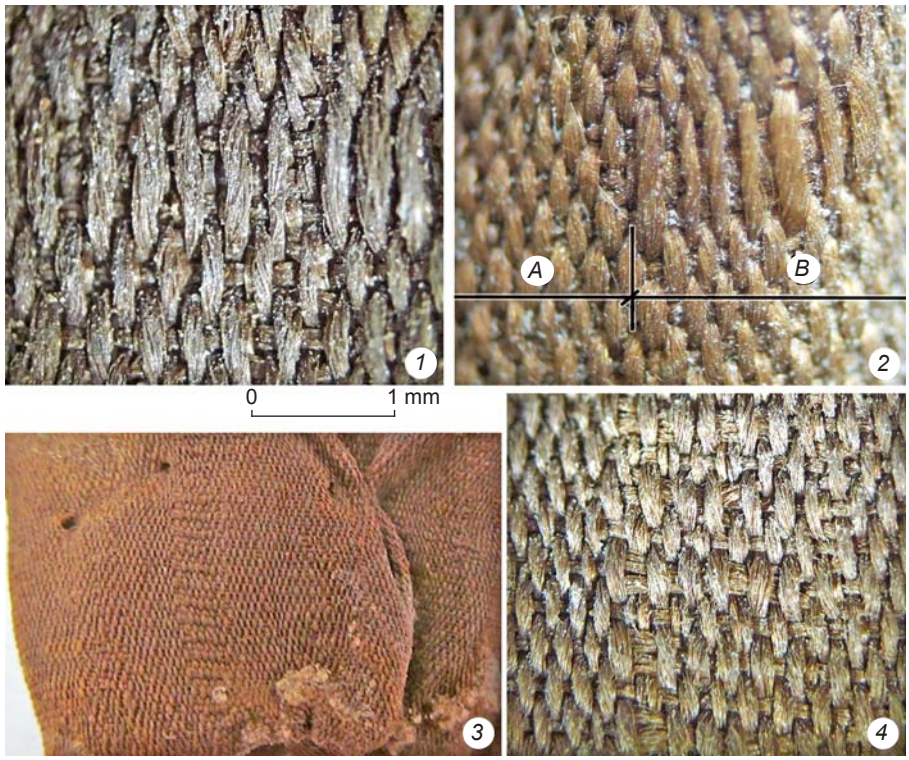

Fig. 3. The results of study of the small (lower) fragment of the fabric.
1 – micrograph of the section with a transverse stripe; *2* – micrograph of the section where it disappears (A – without a stripe; B – with it); *3* – vertical stripe on the fabric (general view of the fragment); *4* – a micrograph of the section with this stripe.

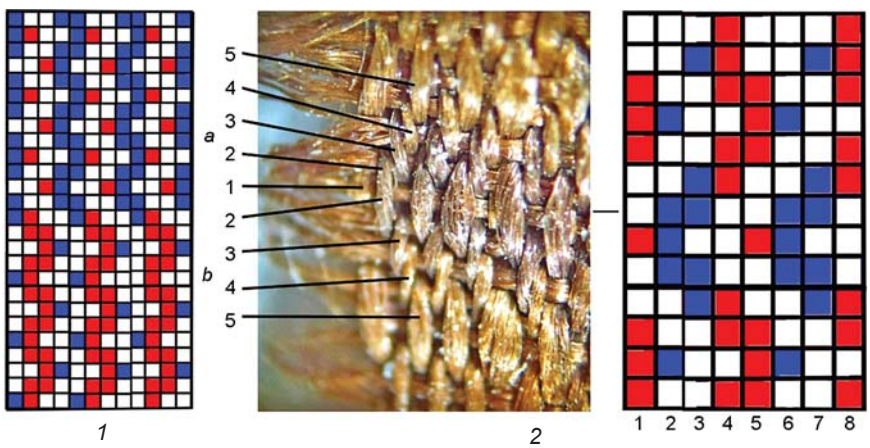

Fig. 4. The results of study of the fabric with the color change on its surface.
1 – weave pattern of colored warp threads: *a* – section where threads of one color predominate, *b* – section where threads of a different color predominate; *2* – micrograph of the section with color change, and the relevant scheme (numbers indicate the order of the warp threads).

threads from one side to the other means a color pattern (on both sides). Microscopic studies of the silk fibers (Fig. 5) showed no difference in color. However, on the images of the warp threads' change, using the minimal computer processing of photographs, it was possible to identify small areas of fabric with a color pattern (Fig. 6, *1*).

Significant contamination is observed in all the threads, but there is very little damage to the fibers (taking into account the age of the fabric). In the dark field, it can be seen that the bulk of the fibers has an iridescent color. This suggests the correct (undisturbed) packing of molecules in the fiber, i.e., a fairly good state of the fiber preservation.

According to the studies conducted, the following characteristics of the fabric from Yaloman II mound 51 have been established: patterned with two warps; the

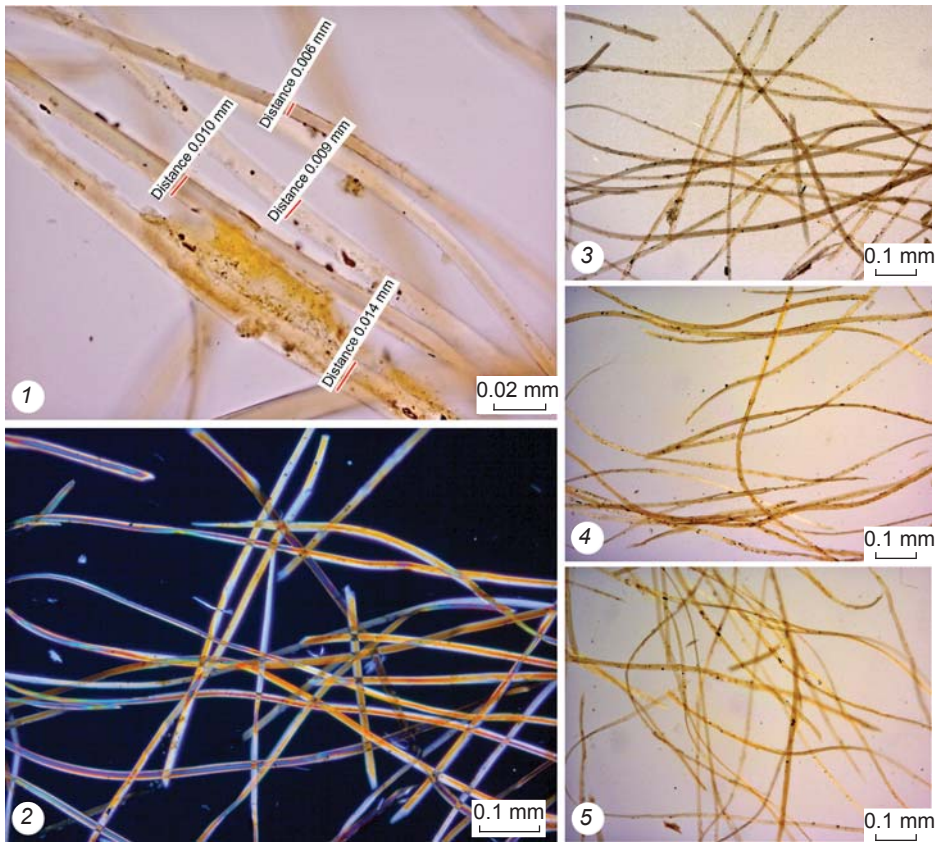

Fig. 5. Micrographs of silk fibers.
1 – in the light field; *2* – in the dark field; *3–5* – threads of light (*3*) and dark (*4*) warp and weft (*5*).

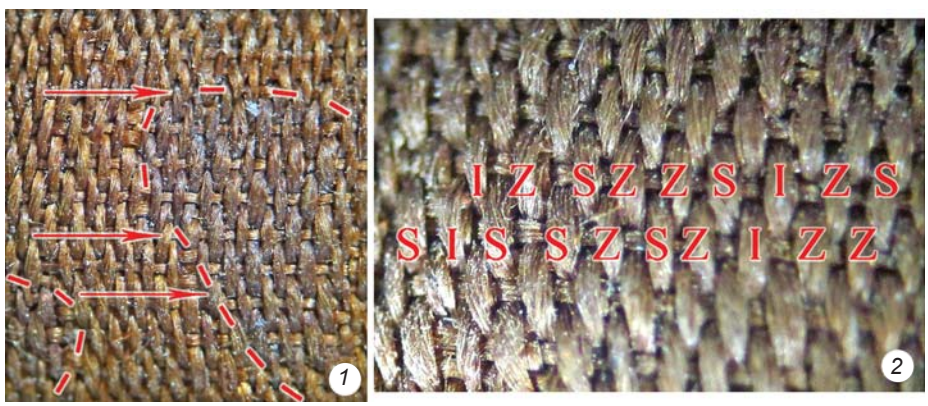

Fig. 6. Micrographs of fabric sections with pattern (*1*) and with threads of various twists (*2*). Arrows show the places with the warp color changes; a dotted line shows the approximate contour of the pattern.

warp threads (both light and dark) are brown silk of various tonality (visual assessment) with weak Z- and S-twist or without it (I); no pattern in the alternation of threads with different twists was noted (Fig. 6, *2*); solitary warp threads break into two strands; the weft threads are brown silk without twist; the average thread thickness is 0.1 mm; the density of the fabric is 120–136/60–66 threads per 1 cm.

Discussion

The Xiongnu nomadic empire existed during the Han period (202 BC to 220 AD). At that time, the weave pattern, in which the warp thread overlapped three weft threads and went under one thread (3:1), was widely used in China. E.I. Lubo-Lesnichenko (1994: 129) argued that this technique had existed since the Yin (or Shang,

1554–1046 BC) period. During the Han dynasty, looms with two treadles were used. "The loom had a wooden frame with two spinning beams—front and rear. The front beam was intended for winding the ready fabric; the warp thread was wound on the rear beam, located at an angle of 45 degrees with respect to the weaver. The loom was equipped with two treadles, with the help of which the shafts parted the warp threads and formed a shed" (Ibid.: 145). Most likely, the considered patterned fabric with two warps is a "double jin" (Ibid.: 130). This fabric is a kind of polychrome decorative silk based on twill or plain weave (Shelkovyi put, 2007: 199). It was popular during the Han dynasty (Hanyu, 1992: 258). However, later, the term "jin" was used to designate brocade as well (Kravtsova, 2004: 734). Therefore, it's easy to get confused. In ancient polychrome fabrics, the pattern was formed by changing the warps, which overlapped three, five, or seven weft threads. This technique existed in Chinese silk weaving until the Tang dynasty (618–907) (Zhao Feng, 1992: 56–57). In modern English-language literature, this type of fabric is identified as "warp-faced compound tabby" (Chinese Silks, 2012: 523).

The fabric under study was polychrome (two colors), so it can most likely be attributed to the *jin* type. "Jin fabrics were produced on a small scale. According to the 'Ceo's Commentary', the gifts sent and received by the rulers of the principalities amounted to 'one basket of jin fabrics' (Sato Gaketoshi, 1978: Vol. 1, p. 71–72)" (Lubo-Lesnichenko, 1994: 130). Such a fabric was used to decorate clothes and to edge the collar and sleeves (Ibid.).

The under-headdress in question was entirely silk, which protected its owner from parasites. The warp threads of two colors were used in weaving the fabric. On order to determine the dyes, additional study on a high-performance liquid chromatograph is required; but such an analysis needs large samples. The microscopic analysis in transmitted light did not identify the color of fibers.

The use of threads with various twist directions may be the result of a conscious artisan's decision, the same as in woolen fabrics of the same time. The ancient Chinese fabrics included silk crepe, but it was woven from the threads of uneven twist (from weak to strong), not of various directions. The present authors have not found descriptions of silk with such characteristics of threads in the literature. It is more likely that this was a natural process, when the weak S-twist was unraveled (i.e. lost the twist (I)) and turned into a weak Z. It is also possible that the warp threads were shifted manually.

The fabric under consideration was produced on a treadle loom (for ancient Chinese looms see: (Becker, Wagner, 2009: 10–15)). The available data suggest that the silk was manufactured in the handicraft workshops of China during the reign of the Han dynasty.

Conclusions

Given its polychromy and high density (more than 100 warp threads per 1 cm), it can be concluded that the headdress from Yaloman II mound 51 was made of an expensive and prestigious Chinese patterned silk fabric. Such fabric was produced in limited quantities to decorate details of clothing worn by the elite. It could have been imported to the Altai as a gift for chanyu-leader and his entourage (Kradin, 2001: 112). In this situation, the mound under study may well be the burial of a young woman from the Xiongnu nomad elite. The burial age was determined on the basis of the grave goods and a small series of radiocarbon dates (Tishkin, Gorbunov, 2006; Tishkin, 2007b: 267–268, 270–274; Tishkin, 2011: Fig. 16). The two calibrated dates (AMS) are 2065 ± 35 (GU-14916) and 2080 ± 35 (GU-14923) BP; they indicate the periods (with a probability of 95.4 %) from 171 BC to 3 AD and from 178 to 36 BC, respectively. These data are well correlated to the historical events and the conclusions of archaeologists. Recently, in the laboratory of the University of California at Irvine (USA), a date of 2085 ± 20 BP (UCIAM-S250255) was derived from the sample of a horse skeleton from a nearby burial mound, which confirmed the previous determinations. In conclusion, it should be noted that ancient Chinese silk has also been found at the Ust-Edigan site (Hudiakov, 2003; Borisenko, Hudiakov, 2004; and others), which has also been attributed to the Xiongnu Age and gave its name to the early stage of the Bulan-Koba culture (Tishkin, Gorbunov, 2006). This research has good prospects, and will expand our knowledge about the culture of the ancient nomads of Inner Asia and their contacts with Han China.

Acknowledgements

The study by A.A. Tishkin was supported by the Russian Science Foundation, Project No. 22-18-00470. The authors are grateful to Y.V. Frolov, Head of the Museum of Archaeology and Ethnography of Altai at the Altai State University, for the opportunity to study the museum exhibit, and to Professor L. Orlando from the University of Toulouse III (France) for the AMS-dating of one specimen.

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Received November 7, 2022.