

## The First Finding of a Frozen Holocene Bison (*Bison priscus* Bojanus, 1827) Carcass in Chukotka

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Findings of Pleistocene mammals from permafrost of the northern parts of Asia and North America are important sources of data on the biology of these species and their natural environment. To date, comprehensive studies on the remains of mammoths, woolly rhinoceros, horses, and primeval bison have been carried out [1–4]. However, similar findings of large mammals of the Holocene Age have been almost unknown until recently. A partial carcass of a primeval bison (*Bison priscus* Boj.) of the Holocene Age was found in 2012 in Bilibino region of Chukchi Autonomous Region, at the mouth of the Rauchua River (69° N, 166° E; Fig. 1). The study of this finding yielded data on the biology and natural environment of primeval bison on Chukotka in subglacial time.

At the place of the finding, the bank of the river has a height of about 0.8 m (at low water). Its deposits are represented by late Pleistocene and Holocene icy aleurites. Superficial erosion of the River and closeness to the sea determine marked oscillations of the water level due to surge phenomena, as well as rainfall floods, which exposed the carcass.

By the moment of finding, the remains of the bison had been lying on the surface of the ground for a long

time. A croup with both hind limbs remained, as well as a big piece of skin from belly and sides. There is little fat in some areas of soft tissues and under the skin. The bones of fore limbs, including soft tissues, vertebrae, broken ribs, the pelvis, the femoral bones, fur with a volume of 50 L in a dried condition, and gastric contents with a volume of 8 L were found. Some large tubular bones and thoracic vertebrae have signs of intense gnawing by a large predator. Primary sex characteristics were not preserved. Indirect characteristics, such as the size and proportions of the basidigital bone, also did not allow identifying the sex of the animal. No data on the season of the death is available. Individual age of the bison, according to knitting of epiphysis with diaphysis, was 6–8 years [5].

**Radiocarbon dating.** Until recently, the geologically oldest finding in Asia was a bison bone from Taimyr with the radiocarbon age of  $8860 \pm 40$  BC (Beta-148623) [6]. The finding of the bison from the Rauchua River also underwent radiocarbon analysis; for this purpose, a fragment of the skin has been used. The <sup>14</sup>C age was  $8030 \pm 70$  BC (SPb-743). This nominally corresponds to the border between the boreal and Atlantic periods of Holocene [7]. To transform the radiocarbon age to calendar age, the OxCal 3.10 software and the Intcal 04 calibration curve have been used [8]. The calibrated age with a probability of  $2\sigma$  (95.4%) is 9100–8640 cal BC. Thus, the finding of the bison on the Rauchua River is the oldest known one. It shows that the primeval bison lived in northeastern Asia until the beginning of middle Holocene.

**Fur.** This part of integument was found separately from the carcass. There are three main groups of hair in its composition, which are different in length, rigidity, thickness, and color. The first group comprises long, up to 40 cm, tough black locks from the tail. The second group comprises black, rather tough, slightly curling locks with a length of 16 cm with brown undercoat at the base. The third group consists of reddish or brown–black, slightly wavy soft locks of undercoat

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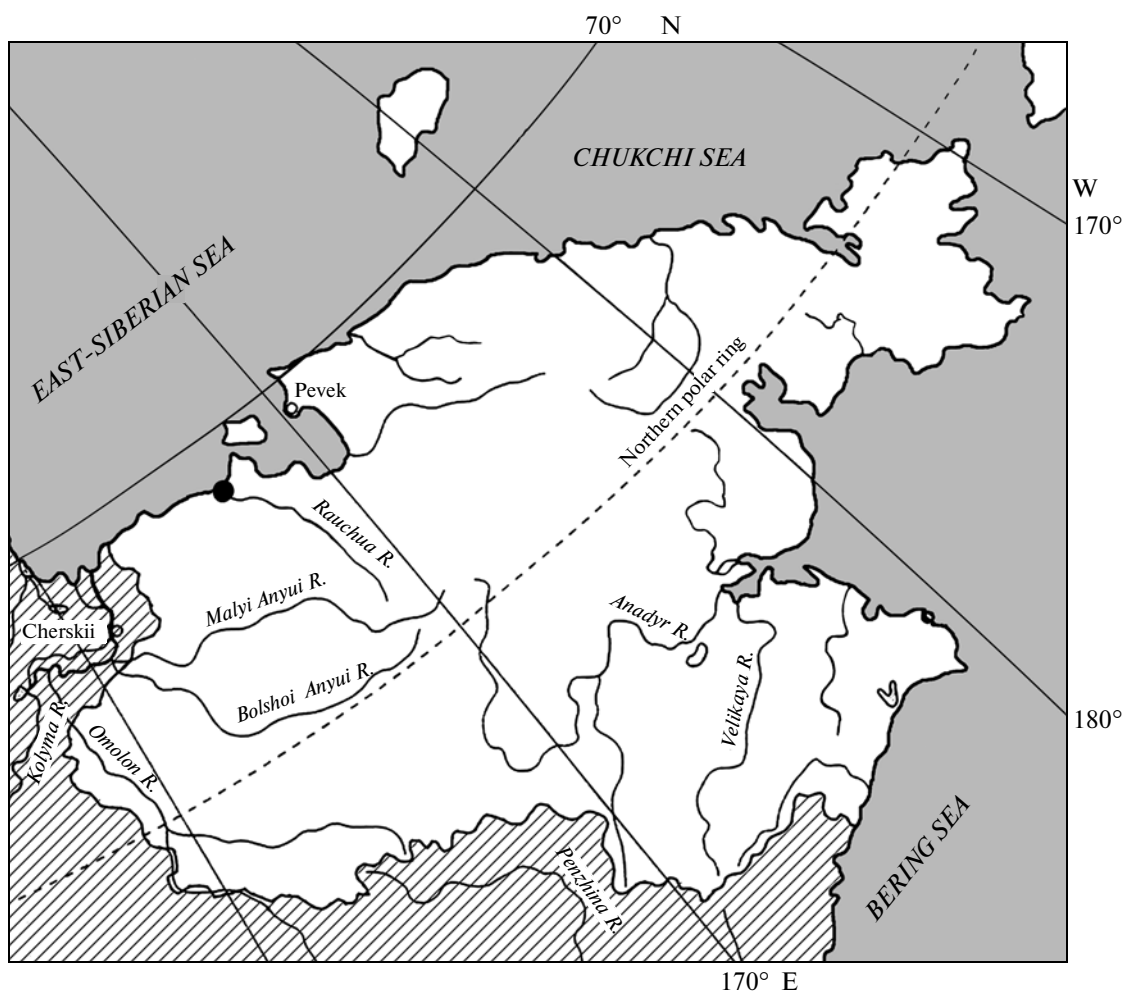


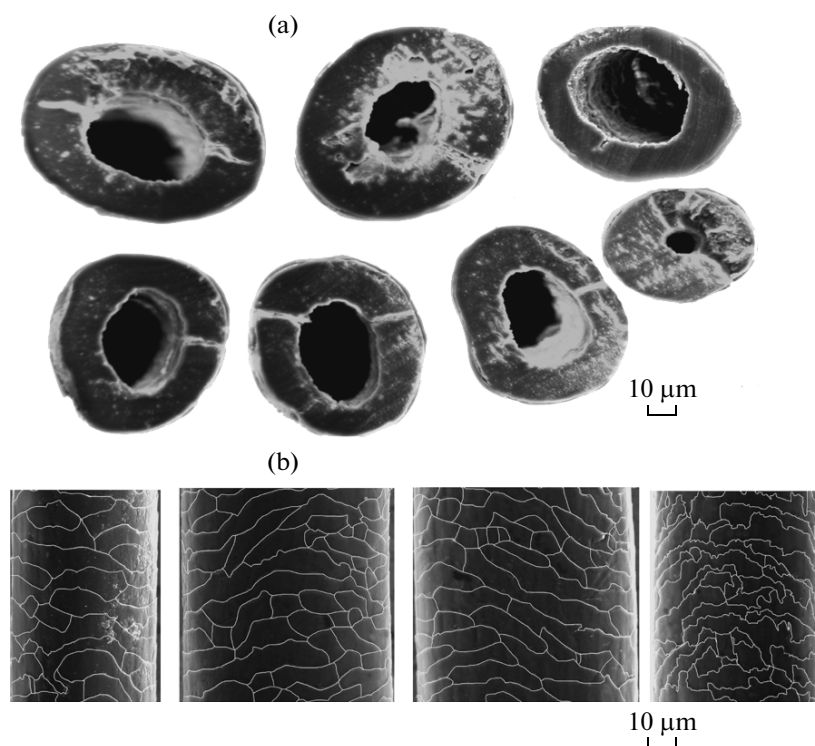
Fig. 1. Location of the frozen bison carcass finding in the Rauchua River region, Chukchi Autonomous Region.

with a length of 7–10 cm with inclusion of tougher black hair.

There are several categories of hair distinguished according to length: guide hair, three orders of guard hair, and two orders of down hair. They form the top level and the thick high undercoat. The thickness of guide hair varies from 90 to 203  $\mu\text{m}$ ; the guard hair of the first order, 90–146  $\mu\text{m}$ ; the guard hair of the second order, 45–113  $\mu\text{m}$ ; thinner downy hair, 17–45  $\mu\text{m}$ . The primeval bison had thicker guide and guard hair but thinner downy hair in comparison to recent auroch (*Bison bonasus*) and bison (*B. bison*); i.e., it had a thicker hair coat, especially down, which ensured better heat-insulating and damping properties of the fur. The thickening of the cortical layer at the expense of core (up to 55% in guard hair) and insignificant flattening of the scape (Fig. 2a) indicate a higher mechanical strength of the hair. Shifting of the core channel to the ventral side of the scape is coupled to the thickening of the protective cortical layer at the dorsal side of the hair, which is the most suffering from the mechan-

ical load. The structure of the core was not preserved. The core is absent in downy hair. The ornament of half-ring- and ring-shaped cuticle and configuration of its scales are similar in hair of all main categories (Fig. 2b). They resemble these scales in the recent auroch and bison, and are, apparently, characteristic of specimens of the subfamily Bovinae. The scales vary in height, configuration, flattening, the level of irregularity of the free edge, and rugosity of the frontal surface at the base and the middle of the scape. The hair of the primeval bison has the largest and the most folded scales among all species compared with respect to these characteristics. The ratios of the scale height to the hair thickness in the middle of the scape of guard hair in the recent auroch and bison (1 : 5.8 and 1 : 6.7, respectively) are slightly less than in the primeval bison (to 1 : 5.3). Ectoparasites or particles of other biological objects have not been found in the hair.

*Gastric contents.* Half-digested plant substance has been studied by several paleobotanical methods (analysis of macroresidues, biomorphs, palynological).



**Fig. 2.** Microstructure of guard hair of the ancient bison: (a) transverse sections (core has been destroyed); (b) the ornament of the cuticle from the base to middle of the hair shaft (from left to right); SEM. Drawing of electronograms. Scale, 10  $\mu\text{m}$ . Sample F-3246/1 of the Ice Age Museum collection.

Plant remains (1400 mL) have been analyzed after laboratory treatment. Plant macrofossils are well-preserved and composed of fragments of vegetative parts, caulis, and leaves of herbaceous plants, mainly, graminoids, sedges, and forbs, ground to different degrees. Moreover, there are crushed branches of bushes without bark, split at the ends (30 pieces with an average length of 25 mm and diameter from 1 to 3 mm); there has been found a cherry fragment 13 mm in length and 5 mm in diameter. There are small numbers of “branchlets” of mosses *Polytrichum* sp., seeds of herbaceous plants and bushes, fragments of leaves of bushes and undershrubs. The following taxa have been identified: Betulaceae, represented by *Duschekia fruticosa* (two scales), *Betula* sect. Nana (two fragments of leaves, one nutlet), Betulaceae (four nutlets); Salicaceae, represented by *Salix* sp. (two bolls); Cyperaceae, represented by *Carex* sp. (89 fruits in covers, 25 fragments of fruits); Poaceae, represented by 18 caryopsis; Brassicaceae, represented by one seed; Caryophyllaceae, represented by *Moehringia* sp. (five seeds); Ranunculaceae, represented by *Ranunculus* cf. *hyperboreus* (three fruits); Rosaceae, represented by *Comarum palustre* (one seed), *Rubus arcticus* (three seeds); Vacciniaceae, represented by *Vaccinium vitis-idaea* (13 leaves); Menyanthaceae, represented by *Menyanthes trifoliata* (one fragment of a seed).

Biomorph analysis has been shown that the most abundant in the gastric content were residues of mosses (the genera *Polytrichum*, *Drepanocladus*, *Aulacomnium*, *Hylocomium*) and meadow grasses, there are fragments of vascular tissues and residues of herbal epidermis. Sphagnous mosses, fragments of trees, bushes, and forest graminoids have not been observed.

The variety of fossil plants is quite high—more than 20 morphotypes. The most part of them has small sizes, usually no larger than 50  $\mu\text{m}$ , which suggests dwarfism of plants. The dominant forms with respect to the number of fossil plants are mosses and poic graminoids (the genera *Poa* sp. (bluegrass) and *Bromus* sp. (bromes)); there is a significant proportion of sedges and forbs. There are a few forms that are characteristic of the genus *Festuca*.

Palinological data show an insignificant amount of pollen. Graminoids (Poaceae) predominate in the presented spectrum. Single pollen grains of sedges (Cyperaceae), wormwoods (*Artemisia*), and the composite family (Asteraceae), as well as birches (*Betula* sp. and *Betula* sect. Nana) and bush alder (*Duschekia fruticosa*) have been found. Single spores of true (*Bryales*) and sphagnous (*Sphagnum*) mosses have been identified. The pollen of conifers has not been found.

Single grains of quartz, hair of bison, and single folds of diatoms have been found in the gastric contents.

Thus, comprehensive paleobotanical studies of the gastric content allow reconstructing not only the diet of the bison, but also pasture stations, which included brushwood of bush alder, dwarf birch, and nettle; relatively drained watershed areas with graminoids, forbs, and underbushes; overmoistened areas with the growth of sedges, buck-bean, and iris. The composition of residues represents habitats of relatively wet areas; however, hygrophytes and psychrophytes have not been found. The forms of fossil plants characteristic of dry conditions are also absent. Based on the biomorph analysis of the gastric content, the vegetation can be reconstructed as poic mesophytic. In general, the spectrum corresponds to vegetative associations of valley and watershed types.

The finding of the primeval bison with the age of about 8000 radiocarbon years shows that relict populations of this species lived on Chukotka before the beginning of the Middle Holocene. The microstructure of the hair of the ancient specimen of the genus *Bison* has been studied, which suggests its better heat-insulating and protective properties in comparison to modern bison and aurochs. The study on the gastric contents of the primeval bison has yielded reliable data

on its diet, with herbaceous plants (poic graminoids and sedges) and bushes being the basis of the diet.

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