

# THE MAMMOTH'S MYSTERIOUS COMPANION: THE MATERIALS OF THE REPUBLICAN ECOLOGICAL AND PALEONTOLOGICAL CAMP FOR SCHOOLCHILDREN "TUSK," YEARS 1997–2013

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## INTRODUCTION

The digitalization of school education and sudden pandemic of the Covid-19 virus made the problems of organizing recreational activities, health improvement, and employment of children during the vacation period particularly important. Local school history is an essential factor in various types of education. One of the students' cognitive types of work is studying the history of their native land in the course of an in-depth research, which could be of scientific interest. There, students act as young scientists. In this regard, the priority direction of the research in the summer camp environment of the Republic of Sakha (Yakutia) is applying paleontological expeditions as the means to promote ecological education. Yakutia is the land of frozen mammoths. The vast territory (3,100,000 km<sup>2</sup>) of the Republic of Sakha (Yakutia) is located in the zone of permafrost and within three time zones. Forty percent of the territory is located beyond the Arctic Circle, in the Arctic zone of Russia.

Permafrost is a unique natural phenomenon. This hard-to-reach subsurface ice is unveiled thanks to the power of flowing water. Each paleontological find is a monument of the past millennia, a reliable witness to the development of life from the ancient times of the past eras. The remoteness of the thousands of years that have irrevocably passed, has generated many questions. Why did the territory of Yakutia, once home to subtropical plants, turn into the pole of the cold? What is permafrost, and when and how did it form? What

are the reasons for the extinction of the mammoth fauna? How did the evolution of the organic world proceed? Where should we look for the ancestral home of Homo sapiens? What awaits us in the future?

In 1997, the Republican Ecological-Paleontological Camp for schoolchildren "Tusk" was founded to unravel the mysteries of the permafrost kingdom. The expedition camp aims to search for traces of mammoth fauna in the Aldan River Basin. (FILIPPOVA, 2019. P. 194). "The Republic of Sakha (Yakutia) has accumulated a lot of experience in organizing schoolchildren's activities to study their native land. P. H. Starovarov was one of the pioneers of the local school history in Yakutia, interesting research work was also carried out in Suntarskiy, Nyurbinskiy, and Tattinskiy districts by teachers G. E. Bessonov, B. N. Andreev, V. L. Senkin (NOGOVITSYN, 2007). Until 2020, several summer ecological-paleontological school camps operated in the Republic: Ellayaada, Mayak, Aiylgy, Omega, and others".

The main goal of the proposed paleontological excursion is to familiarize students with the nature of their homeland. It also includes paleontological investigation of promising locations of mammoth fauna in the vicinity of the camp; teaching students the methods and skills of research work in the field; collecting paleontological material;

forming an environmentally competent personality and the sense of collectivity (PROTODYAKONOV ET al., 2016).

Given this position in the researched problem of woolly rhinoceros, the central questions are the following:

- When and where did woolly rhinoceroses live? How many species of woolly rhinoceros have been studied?
- How do we determine the age and species of woolly rhinoceroses?
- When and where were fossil skulls of woolly rhinoceroses found by the "Tusk" schoolchildren expedition camp?
- How to identify the differences and similarities of fossil skulls of woolly rhinoceros?

## LITERATURE REVIEW

The woolly rhinoceros was a typical representative of the so-called mammoth fauna. The main reasons for its extinction, 8-14 thousand years ago, are considered to be climate changes and related changes in the flora. The woolly rhinoceros was generally similar in appearance to the modern rhinoceros. However, the ancient animal slightly differed in its body shape and in some details of its constitution. The woolly rhinoceros was covered with thick, long hair and fed mainly on green plants. The population of this animal represented two separate, although closely related, species: *Coelodonta antiquitatis* (the ancient one); and *Coelodonta lenensis* (lit. - from Lena, after the Lena River).

"The Lena rhinoceros" evolved in the cold climate of the open landscapes of Central Asia. This species of rhinoceros could be distinguished by its large size, powerful constitution, shortened limbs, and thickened tooth enamel. All of its physical features indicate that the Lena Rhinoceros was adapted to the cold weather and its rough diet. The animal quickly penetrated into northern latitudes and spread to the Trans-Baikal region and Yakutia. During the maximum glacial advance, the woolly rhinoceros spread throughout the rest of Asia and settled in Europe. In Western Europe, according to research, there was a rhinoceros that is usually considered a woolly rhinoceros (*Coelodonta antiquitatis*). It was somewhat smaller than *C. lenensis* and was more typical of the biotope dominated by the forest-steppe. Despite the penetration of the larger *C. lenensis* into its range during the cold period, it retained its niche.

During the warmer periods, the woolly rhinoceros expanded its range, equally penetrating into Eastern Europe and further east into Siberia. Differences in the skull structure of European and Siberian rhinoceroses were noticed in the 1970s. The issue of subspecies of the woolly rhinoceros is not completely clarified. However, most sources agree that there were several subspecies and local forms of this animal in the vast habitat. They differed, apart from minor morphological details, by body shape and size. At the same time, the division of the woolly rhinoceros into species and subspecies requires some further studies. Only new fossil finds can provide more information on these questions (VASILIEV et al., 2008; GARUTT et al., 1998, 2001; SVETOVIDOV et al., 1977; Turner, 2009).

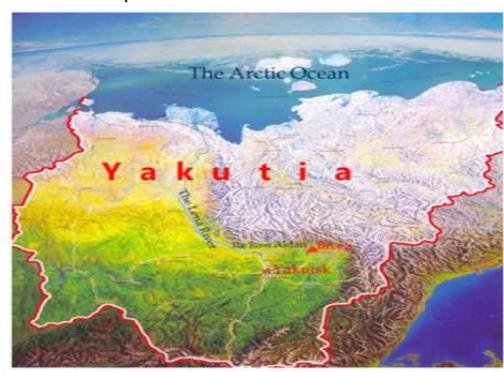
The issues of determining the age and species of woolly rhinoceroses were considered in the works of Gromov (1950), Garutt (1998), Boeskorov G.G. et al. (2016), Kassal (2016), Ivanov et al. (2016), Novgorodov et al. (2018), Plotnikov et al. (2019), Ponomarev I. V. et al. (2019), Puzachenko et al. (2019). To determine the age of archaeological and geological objects, so far, the method of radiocarbon dating has been used. Radiocarbon analysis allows to state the age of biological remains. Radiocarbon dating method is performed in special laboratories. Therefore, the most valuable bone remains, their metric and non-metric characteristics are described during the excavations. With the development of information technology, "graphic studies, verbal modeling and analysis, including descriptive and graphic elements, their interpretations from modern biological positions" commenced to be applied to the study of fossils of woolly rhinoceroses (KASSAL, 2016. P. 26). Among scientists, fossil rhinoceroses are a tough group of mammals to study, since their bone remains are relatively scarce.

## MATERIALS AND METHODS

The materials have an experimental base. The Republican ecological and paleontological camp for schoolchildren, "Tusk," founded in 1973, became a testing ground for multi-day, touristic and local, historiographical tours to the nearby natural and geological excavations. The camp is a search and research expedition on small watercrafts. In 1997, a permanent base was established on the right bank of the Aldan-Kuchay river channel, opposite the village of Ust-Tatta of the Tattinskiy Ulus. Ust-Tatta opened new routes for conducting and organizing paleontological expeditions for schoolchildren. As a result of the annual summer prospecting and research trips to the nearby natural and geological excavations, the remains of 57 fossilized animals were found by young paleontologists. All these materials from the expeditions are stored in the camp's museum laboratory. Since 2013, the base of the camp "Tusk" has become a testing ground for monitoring paleontology in the Tattinskiy Ulus of the Republic of Sakha (Yakutia). Four generations of "Tusk" have grown up during the times of the camp's existence.

P. D. Maksimov, a teacher of biology at the Ust-Tatta Secondary School, has been conducting paleontological excavations of mammoth fauna remains in the Aldan River basin for 47 years, together with schoolchildren and scientists. Thanks to these expeditions, unique paleontological discoveries have been made, significant not only within the republic, but also worldwide. In 1976, young tourists discovered the skeleton of a woolly rhinoceros, the fourth find of its kind in the world. Since 2000, the skeleton has been exhibited in the Mammoth Museum of the republic. The objects of the search and research expeditions of "Tusk" are the nearby geological reference sections along the Aldan River: the Mamontova Mountain and Rossypnoe.

**Fig. 1.** The city of Yakutsk – the capital of the of the Republic of Sakha (Yakutia), ▲ location of the camp "Tusk"



**Fig. 2.** Base of the camp "Tusk", its leader P. D. Maksimov



**Source:** Images - Archives of authors

**Fig. 3.** The first generation of the "Tusk" students. Mammoth Mountain. Aan Appa. Year 1973.

**Fig. 4.** The second generation of the "Tusk" students. Year 1997.



**Source:** Images - Archives of authors

**Fig. 5.** The third generation of the "Tusk" students. Year 2010.



**Fig. 6.** The car tour along the traces of the oldest animals of the mammoth fauna in Tattinskiy ulus, dedicated to the 45th anniversary of the camp "Tusk", 2017.



**Source:** Images - Archives of authors

**Fig. 7.** The world's fourth woolly rhinoceros skeleton, found by members of the 1976 camp "Tusk" expedition, which is on display at the Mammoth Museum of the Republic.



**Fig. 8.** Trips are made on the river Aldan in small watercrafts.



**Source:** Images - Archives of authors

The route of Mammoth Mountain is called Leke Khaya in the Yakut language. Mammoth Mountain is a unique natural object. On its geological horizons you can see the whole history of life on earth: Neogene, Miocene, Pleistocene, and Paleolithic. This mountain is located on the left bank of the Aldan River on the territories of the Tomponskiy and Tattinskiy uluses of the Republic of Sakha (Yakutia). On Mammoth mountain, 80 meters deep and about 5 km long, one can see the frozen traces of the past 23 million years. In terms of completeness of the

geological record, there is no equivalent surface exposure in the world. On Mammoth Mountain, from early spring to late autumn, there is a process of destruction and exposure along the whole length of the geological section (5–13 km). This process enables to discover unique research objects. On Mammoth Mountain, participants of expeditions are offered a one-day hike. Aan-Appa is a stream that flows into the Aldan River and forms the largest gorge on Mammoth Mountain. Since 1973, 12 remains of mammoth fauna have been discovered along this paleontological trail. Within a small section of the exposure, the young paleontologists found remains of mammoth, woolly rhinoceros, bison, tiglion, fossil deer, musk ox, elk, horse, and wolverine. In their search and research work the expedition members focus on studying the reasons of extinction of mammoth fauna animals. Unfortunately, there is no unified answer for it in the academic world. There are many mutually exclusive hypotheses.

**Fig. 9.** Geological horizons of Mammoth Mountain



**Source:** Images - Archives of authors

**Fig. 10, 11.** The search for the traces of mammoth fauna.



**Source:** Images - Archives of authors

The Rossypnoe (Tyulyakh) route is located along the Aldan River, 30 km lower from the main base "Kuchaiy". The base-geological section belongs to the Quaternary period. The height of the river terrace is up to 30 meters. The length of the bend is 3 km. Until 2001, this route was an optional one. Previously, the organizers of the expedition held occasional one-day hikes. Now the young researchers are conducting regular observations. The bones found in this area are characterized by a good preservation of color and the soundness of structure. The presence of more preserved remains of mammoth fauna animals at this site is explained by the rapidity of thawing of the ice complex. The outcrop is poorly studied. In the future, participants of expedition plan to make the paleontological map and continue constant observations (MAKSIMOV, 2006, p. 18).

**Fig. 12.** Route Rassypnoe (Tulakh)



**Source:** Images - Archives of authors

**Fig. 13, 14.** Permafrost. Appearance of the underground ice on the Rassypnoe route. Year 2001.



**Source:** Images - Archives of authors

Special literature (GROMOVA, 1950), as well as the experience of many years of actual observations by P. D. Maximov, biology teacher and head of the "Tusk" camp, were used to identify and anatomically define the osteological material. The total of four skulls of the woolly rhinoceros were collected. The materials are stored in the museum-laboratory of the "Tusk" camp.

**Fig. 15, 16.** Museum-laboratory of the "Tusk" camp.



Source: Images - Archives of authors



**Fig. 17.** In the museum, young researchers study materials and write scientific reports.

**Fig. 18.** Winners of the Russian contest "Step into the Future. Year 2000. The second generation of the campers. From the left to the right: Igor Yevseev, Petr Dmitrievich Maksimov, the head, Anton Golikov. At present, Igor and Anton work in the mining industry.



Source: Images - Archives of authors



**Fig. 19.** Vitaly Filippov, Veronica Maximova – the participants of the city and national conferences, year 2016. The third generation of the campers.

**Fig. 20.** Tourists from Japan: the director of Nippon Television Nakatani san. Close to him is Matsuta san, the world champion in deep diving and a member of the expedition of the famous explorer of the world ocean Jean-Yves Cousteau. To the left is the famous Takada san, the world champion in bare-knuckle fighting and tour organizer V. Potapov. Year 2010.



**Source:** Images - Archives of authors

**Fig. 21.** Members of the international expedition, consisting of Japanese, Moscow scientists have witnessed that the ancient bacteria that can stimulate the vital activity of organisms were found near the permafrost strata. The leader is Professor A. Brushkov. Mamontova Mountain. Year 2008.



**Source:** Images - Archives of authors

A brief description of the experiment design. The first would be the definition of the collected material with the use of book definers on paleontology, electronic sources, etc. The second is taking measurements of paleontological specimens, labeling, photo-fixation of the exhibits. After that, all the collected material according to the systematic (species) principle are laid out in the palaeontological collection of the camp, and a map of locations of remains of mammoth fauna and the most ancient plants of thermophilic flora is made.

## RESULTS

In 2016, after an expedition trip to the museum-laboratory, young paleontologists with their leader conducted an anatomical study of fossil skulls of woolly rhinoceroses, found during the long painstaking work at the camp. The results are recorded in Table 1 and presented in the photographs (see Fig. 22-28).

**Table 1.** The skulls of rhinoceros

No	Year	Place	Weight, kg	Type and composition of the skull
1	1995	Rassypnoy (Tyulyah)	10	1. Skull of an adult animal. 2. Blunt-faced. 3. The skulls are massive, whole.

				<ol style="list-style-type: none"> <li>4. The place of growth of the second horn is distinct.</li> <li>5. The Lena species.</li> </ol>
2	2003	Mammoth Mountain	<p>15</p> 	<ol style="list-style-type: none"> <li>1. Skull of an adult animal.</li> <li>2. Blunt-faced.</li> <li>3. The skulls are massive, whole.</li> <li>4. The place of growth of the second horn is distinct.</li> <li>5. The Lena species.</li> </ol>
3	2006	Mammoth Mountain	<p>17,5</p> 	<ol style="list-style-type: none"> <li>1. Skull of an adult animal.</li> <li>2. Blunt-faced.</li> <li>3. The skulls are massive, whole.</li> <li>4. The place of growth of the second horn is distinct.</li> <li>5. The Lena species.</li> </ol>
4	2010	Mammoth Mountain	<p>5</p> 	<ol style="list-style-type: none"> <li>1. Skull of an adult animal.</li> <li>2. Narrow-faced.</li> <li>3. Strongly expressed cranial joints.</li> <li>4. Place of growth of second horn is not expressed.</li> <li>5. Unknown species.</li> </ol>

**Source:** Search data.

Fig. 22. The skulls of woolly rhinoceroses №4, №1



**Source:** Images - Archives of authors

**Fig. 23, 24.** The skulls of woolly rhinoceroses №2, №3.



**Source:** Images - Archives of authors

The young paleontologists were particularly intrigued by the anatomical structure of skull No. 4. This skull differs greatly from the others. It should be noted that its size is smaller. Skull No. 4 has strongly pronounced cranial joints, which are absent in the other three. In No. 1, 2 and 3, the brain cases are strong and solid. The most important point is that skull No. 4 is narrow-faced, whereas the others are blunt-faced. Also, on skull No. 4, the place of growth of the second horn is not expressed. In terms of tooth construction (size), the skull belongs to a young, yet mature fossilized animal. This is confirmed by the large size of the teeth and molars, which are at the stage of gum eruption. The distance between the external walls of the cheekbone is 18.02 cm. And in No. 1, 2 and 3, it varies from 15.02 cm to 18 cm (see Fig. 26-28). All these findings led the young researchers to the conclusion that the skull probably belongs to another subspecies of the woolly rhinoceros. According to the participants of the expedition, the study of one specimen is not enough to obtain reliable evidence; consultations of specialists and further search and research work are necessary.

**Fig. 25.** The teeth construction of the skull of the woolly rhinoceros No. 4



**Source:** Images - Archives of authors

**Fig. 26, 27.** The skull No. 4, has 18.02 cm distance between the outer walls of the cheekbone



**Source:** Images - Archives of authors

**Fig. 28.** The skull of the woolly rhinoceros No. 4.



**Source:** Images - Archives of authors

Therefore, based on the signs of divergence in the anatomical structure of skull No. 4, the young paleontologists came to the following conclusions:

1. This skull probably belongs to another subspecies of fossilized animal. The participants of the expedition named this subspecies "Cheeked Rhinoceros" or "Narrow-Faced Rhinoceros."

2. The young paleontologists stipulated the assumption that at the time when the animals of the mammoth fauna flourished, there might have been some species or subspecies of woolly rhinoceros in the territory of Paleo-Yakutia in addition to the Lena species.
3. To prove the existence of other species or subspecies of woolly rhinoceros, it is necessary to continue the expedition and research work.

According to the results of the work carried out in 2017, Vitaly Filippov, a pupil of 7B class of school No. 31 of Yakutsk successfully participated in the national research conference "Step to the Future" and in the Academy of Sciences of the Republic of Sakha (Yakutia). So, the unique discovery of the unknown skull of the woolly rhinoceros, found on the Mamontova Mountain in 2010, lifts the veil of the ancient history of the Republic of Sakha (Yakutia).

## DISCUSSION

In order to compare the results with other studies, let us highlight some scientific works devoted to approximate topics. The scope of such research is very diverse and has been covered in a number of scientific areas. Thus, the work of Boeskorov G. G., Nogovitsyn P. R. et al. (2016) presents data on new findings of the mammoth fauna remains in the Middle Lena basin, on the basis of which the species composition of large mammals of the Late Neo-Pleistocene, represented by 11 species, was clarified. A series of new radiocarbon dating has been obtained, allowing us to state that mass burials of Pleistocene mammal remains were created in this region during the Karginsky interstadial (24-55 thousand years ago).

The article by N. V. Garutt and G. G. Boeskorov (2001) summarizes the nearly two-hundred-year-long history of the studies of fossil rhinoceroses of Elasmotherians, first described by Gotthelf Fischer in 1808. The authors discuss the issues concerning their chorological and chronological distributions, as well as demonstrate and analyze morphological and outgrowth reconstructions proposed by different researchers. The fate of the G. Fischer type material originally stored in the funds of the Natural History Museum of the Imperial Moscow University (now the V. I. Vernadsky Geological Museum of the Russian Academy of Sciences) is traced. The merits of V. A. Teriaev, associate professor at MGRI, in the study of elasmotherium are highlighted. A list of Elasmotherium remains stored in the collections of the Vernadsky Geological Museum of the Russian Academy of Sciences has been compiled.

The examined by D.A. Ivanov and A.A. Chubura (2016) exemplar could have been a large male. The article describes the find of a part of the postcranial skeleton of the woolly rhinoceros (Blumenbach "Coelodonta antiquitatis", 1799) made during archaeological explorations on the Vozha River in the Ryazan Region (Russia). The morphometry of the bones allows us to speak about the sizes characteristic of the representatives of the East European population of the animal in the period when the population was not under ecological stress.

With the help of the author's method of B. Yu. Kassal (2016) it is possible to differentiate the species of Pleistocene images of bipedal herbivores and lysoid rhinoceroses that simultaneously inhabited Northern Eurasia in the period 3,100-13,000 years ago. The totality of the known Pleistocene art objects with images of bipedal rhinoceroses allows us to estimate their main biological and ethological features.

The fossil woolly rhinoceros, *Coelodonta antiquitatis* (Blum.), was widespread almost throughout the Northern Eurasia in the Late Pleistocene. Because of its wide distribution, this species is an important biostratigraphic indicator of the Late Pleistocene. Until recently, information on finds of woolly rhinoceros remains in the upper Kolyma River was extremely scarce. In years 2014-2015, during the field work on the right bank of the middle Kolyma River at the Irilyakh-Siene site (Verkhnekolymsky District), a large number of mammoth fauna remains were collected, including three skulls and a shoulder bone of a woolly rhinoceros.

The article by G. P. Novgorodov, G. G. Boeskorov, and M. Yu. Cheprasov (2018) provides a preliminary description of the morphological features of these finds. In order to complete the data on rhinoceros morphology from the Kolyma River basin, a study of metric and non-metric features of rhinoceros skulls and humerus was conducted. We used the methods of studying the osteological material accepted in paleontology. Determination of the individual age of

rhinoceros skulls was carried out according to the method of M. Borsuk-Bialynicki (1973). The rhinoceros humeral bone was dated by radiocarbon method at the University of Poznan (Poland). It was established that its size is sufficiently large, nevertheless, according to the main parameters it is inferior to the similar bone of the adult female rhinoceros from Churapcha (Churapcha district, Republic of Sakha (Yakutia)). It is possible that the humerus from Irilyakh-Siena belonged to an undersized female. A preliminary comparison of the sizes of rhinoceros skulls from the middle and lower reaches of the Kolyma River indicates their considerable similarity in most measurements. Preliminary conclusions are made that the Kolyma basin was inhabited in the Late Pleistocene by a rather uniform, not very large woolly rhinoceros morph. In the future, it is planned to obtain radiocarbon dating of the new finds and to compare their sizes with the previously described specimens, which will allow a more reasonable judgment on the dimensional variability of *C. antiquitatis* in Yakutia. The new finds supplement the information on the distribution of this species in Yakutia in the Late Pleistocene.

The work of V. V. Plotnikov, A. V. Protopopov, A. I. Klimovsky, and J. Van Der Plicht (2019) presented results of previously unexplored bone remains of woolly rhinoceroses of varying individual ages from a new mammoth fauna locality discovered on the Ogorokha River (Indigirka River basin, Abyisky District, Republic of Sakha (Yakutia)). The basin of the river Indigirka is known for mammoth fauna finds along all its length. A number of reference locations and such unique finds as Mylakhchi bison and Aby mammoth, Berelekh "cemetery" of mammoths were discovered and investigated here. In recent years, well-preserved mummies of cave lion cubs and a baby woolly rhinoceros carcass fragment have been discovered. The possibility of new paleontological finds in the area remains high. The fieldwork was carried out for three years, starting in 2014. During the work, the remains of almost all representatives of the so-called mammoth fauna were collected. Systematization was carried out by distributing each find by bone type and field numbering. Morphometric data from previously studied localities were used for a comparative determination of bone remains. The comparative analysis made it possible to determine the individual age, sex, and possible cause of death for these animals. The remains of the embryonic period of development of woolly rhinoceros calves are of particular interest, as they occur quite rarely. The extremely high concentration of bones and carcasses in a relatively small area suggests some natural entrapment in this area during the late Pleistocene. The new location of mammoth fauna on the Ogorokha River is of great interest to science and undoubtedly requires more detailed and comprehensive research.

The article by I. V. Ponomarev and G. G. Boeskorov (2019) presented the study of new paleontological material collected during the 2014 fieldwork and the "Lena Pillars" summer school in 2018. In addition, bone remains of mammoth fauna stored in the Kachikatsy village museum and those found by Oktemsky lyceum students in the summer of 2016 were identified and investigated. Here, the article provides the descriptions of the most valuable bone remains, their metric and non-metric features. The study of new mammoth fauna findings shows that mammoth, woolly rhinoceros, Lena horse, red deer, elk, bison, and bighorn sheep are present in the Buotama River basin and its adjacent territories. The presence of the cave lion in this region is established reliably for the first time. Remains of carnivores are found much less frequently than remains of more numerous herbivorous animals. This is due to the rule of the Eltonian ecological pyramid. In this regard, the finding of a cave lion skull fragment at Buotama is exceptionally rare. New finds of mammoth fauna remains add to the information on the species composition and its distribution in the modern territory of the "Lena Pillars Nature Park." The authors believe that mammoth fauna locations in this specially protected natural area should be included in the list of natural monuments.

A. Yu. Puzachenko, I. V. Kirillova, F. K. Shidlovsky, and V. A. Levchenko (2019) studied 63 woolly rhinoceros skulls from northeastern Russia (northwestern Chukotka, northeastern Yakutia) from the collection of the "Ice Age" theater and museum (Moscow). For the first time, sex dimorphism and variability of skull size and shape were investigated by univariate and multivariate statistical methods. In the article, the peculiarities of variability, probably related to sex, are described. These features are expressed in a different set of measurements for males and females, the variability of which does not depend on the variation of the total skull dimensions and the differences in allometric patterns of males and females. The authors found

statistically significant morphological heterogeneity of samples of both males and females. The heterogeneity is caused by the fact that there are individuals of two size groups in each of these samples, and the differences in sizes are not connected with age variability. Analysis of published radiocarbon dating has suggested a decrease in overall skull size for this rhinoceros species at the end of the MIS 3 megainterstadial to the beginning of the MIS 2 stadial in northeast Asia. Additional data on the geological age of the examined specimens are needed to test the hypothesis.

Thus, a comparative analysis of the research works on the subject allows us to draw the following conclusion. The remains of the skull of the woolly rhinoceros are found all over Russia, especially more preserved remains were found in Yakutia in connection with the widespread development of permafrost. Large parts of all known finds of mammoths and other extinct animals with preserved soft tissues are concentrated in the subsoil of the republic. Excavations and study of such finds lead to understanding of the reasons of their death, taphonomic features of burials, knowledge of pathological-anatomical and exterior features of ancient mammal organisms, revealing regularities of evolutionary processes, as well as climate fluctuations and formation of vegetation cover and other habitat components. The results of these studies are necessary for the study of the evolution vector, questions of phylogenetic relationships of the present animals with Pleistocene ancestors and problems of their survival in the changing conditions of the modern world.

On the other hand, it is important to note that the main base of the camp is located on the bank of the Aldan-Kuchaay river channel, opposite the village Ust-Tatta of the Tattinsky ulus. The school camp is equipped and furnished with everything that is necessary for carrying out exploratory and research expeditions. There is a canteen, a yakutian balagan, double-rooms campsites, a bathhouse, a hunting hut and a museum-laboratory. Trips along the Aldan River were made in summer on small swimming vessels. In order to study a more realistic picture of the past, the head of the "Tusk" camp, P. D. Maksimov, developed a general scheme of the expedition. The map includes the following routes: "Chagdai", "Ikhine", "Baken", "Khandyga", "Mamontova" and "Tyulyakh". Along these paleontological trails young tourists make interesting, cognitive hikes. During the trip, they get acquainted with the land of frozen mammoths. During one week the organizers of the expedition try to show schoolchildren as much as possible about the long historical development of life on earth. During the hike, students had to decide for themselves what is true: the hypotheses of scientists or the versions extracted from the depths of reality. Young paleontologists relied on everything they saw with their own eyes in the wilderness, as well as the photographs of the surrounding reality and paleontological findings. Active contact with the nature has left a deep mark on the life and work of the young people's personalities. The best assessment of the camp was to receive positive feedback from parents, as well as the warm meetings of young tourists decades after they left the camp. Analyzing the experience of the search and research expedition of schoolchildren in permafrost conditions, the following provisions for teaching and educating schoolchildren in conducting elementary paleontological research were highlighted:

- Permafrost, a unique natural phenomenon that has preserved the traces of the historical past of the development of life on earth for thousands of years.
- The mighty Siberian river Aldan, eroding the permafrost soil to a depth of 80 meters, forms the famous Mamontova Mountain. There is no other natural exposure in the world in terms of completeness of geological record. Its layers allow tracing the historical development of life for 23 million years.
- Paleontological expeditions have a number of advantages. Students collect their own material and observe fossil remains in their natural positions, which can further arouse interest in the nature of their native land.
- Based on the material collected, you can build your own paleontological collection, which can be an invaluable and original source for learning the basics of paleontological science, the evolution of the biosphere in the Quaternary period, studying the history of the Ice Age fauna, analyzing the overall picture of the development of life on Earth and predicting the future.

- The collected exhibits are the objects of schoolchildren's research works for participation in various scientific conferences, general improvement of ecological literacy and increasing interest in research activities.
- It is necessary to engage the child into science exclusively in his or her own interests. At the initial stage of research, children should not be overloaded with complex descriptive analyses. Scientific methods should be the simplest, most accessible and illustrative.
  - With live contemplation, during an exploratory hike in the paleoecology of bygone eras, the young tourist will understand the true value of life.
- The expedition is conducted directly in the wild taiga itself, which allows you to find out the diversity of objects of wildlife. Features of their structure, functioning and interaction in certain conditions.
- During excursions for young explorers nature is shown as a holistic formation with established numerous interactions, the destruction of which generates environmental problems.
- Sunshine, clean air, water, the beauty of taiga, the winds of permafrost and outdoor activities cleanse the soul of a young person from the negative precipitants of modern civilization, brings up a sense of caring attitudes towards the native nature.
- Excursions are carried out on small watercrafts along the river Aldan along the composed route: "Chagdai," "Ikhine," "Baken," "Khandyga," "Mamontova," "Tyulyakh."
- Children over 13 years old who have some camping skills can take part in the expedition.
- Young campers should be psychologically prepared for the extreme conditions of living outside their comfort zone.
- The group should consist of 8-9 children.
- The expedition lasts no longer than one week.
- Supplementing the menu of participants of multi-day hikes with fresh high-calorie products is a prerequisite for the restoration of energy expenditures of teenagers.

It is necessary to underline that following the results of the researches of edge of the frozen mammoths on the river Aldan within 48 years the following facts have been revealed:

1. Almost all remains of the most ancient animals were found on the same geological horizons: in ice complexes (in frozen mud) with absence of traces of early weathering on skeleton bones of fossil animals.
2. Several fossil animals belonging to different species were found in the same geological horizon. Among them: tigers, woolly rhinoceroses, mammoths, bison, deer, horses, elk.
3. Rare findings with whole carcasses and skeletons of fossil animals of mammoth fauna.
4. Perfect preservation of soft tissues of the most ancient animals without allocated cadaveric poison, without pathogenic microorganisms in embrace of permafrost soil.
5. Identity of the species composition of plant remains in the stomach of fossil animals with modern species of growing plants and poorly developed humus over the dead loamy-ice complex.

6. The hard eolian soil formed by evaporation of water from the structure of the frozen mud-ice complex excludes the assumption by scientists that mammoths walked on the hard surface of eolian plains.

Consequently, the theory of the "Tusk" camp participants is that the mammoth fauna reoresentatives died as a result of a global catastrophe on the Earth, which caused the formation of a mudslide and was accompanied by the onset of a single-step severe cold. This could have happened when the axis of rotation of the earth was changed by an extraterrestrial force. It should be stated that the head of the camp, P. D. Maksimov, has several publications. Under his guidance, many young participants of the expedition successfully participated in republican, Russian, and international scientific and practical conferences and exhibitions. Some Tusk's second-and third-generation campers – Anton Golikov, Igor Evseev, and Valerian Maksimov – have chosen the profession of mining engineer and successfully worked in mining industry enterprises. At the same time, camp "Tusk" is the winner of the IV Moscow international exhibition "School-2000," the winner of the governmental grant of the Republic of Sakha (Yakutia) in the Year of Children and Children's Sports, winner of the International Children's Fund "Children of Sakha-Asia," a participant of the international exhibition in Rovaniemi (Finland), winner of the All-Russian contest of young researchers "Step into the Future" in 2008. "Paleontological map of mammoth fauna traces on the Aldan River of the school camp 'Tusk' for 1973-2007" was awarded a diploma of the second degree, signed personally by the corresponding member of the Russian Academy of Sciences S. P. Kapitsa. In years 2006-2008, a traveling virtual exhibition of camp "Tusk" was organized in the Republican Museum of Schoolchildren Achievement. In years 2008-2011, the camp was visited by participants of the international expedition "Bacteria of eternal youth" led by A. Brushkov as well as tourists from Austria, Norway, and Japan. In 2014, the camp won a grant from the Ministry of Nature Protection of the Republic of Sakha (Yakutia). In 2017, in honor of the 45th anniversary of the camp, young fourth-generation Tusks students, together with camp director P. D. Maksimov, organized a driving tour from Tatta to Churapcha along the traces of the oldest animals of the mammoth fauna.

The camp mainly cooperates with the World Mammoth Museum of the Research Institute of Applied Ecology of the North, of the Academy of Sciences of the Republic of Sakha (Yakutia). Since 2013, the camp "Tusk" has become the base for monitoring paleontology in the Tattilus ulus of the Republic of Sakha (Yakutia). Primarily, the camp initiated search and research expeditions of schoolchildren to unravel the mysteries of the permafrost kingdom in the land of frozen mammoths that have continued from generation to generation. (MAKSIMOV, 2000, 2006, 2012, 2017, 2021; FILIPPOVA et al. 2019).

## CONCLUSIONS

Paleontology is the science that studies the ancient life. It seeks to describe phenomena of the past to reconstruct their origins. This field of science searches for information about several aspects of ancient organisms: "their identity and origin, their environment and evolution, and what they can tell us about the Earth's organic and non-organic past" [Wikipedia]. In endeavoring to gain a better understanding of the past, paleontologists and other historical scientists often construct a series of hypotheses about causes, and then launch explorations for evidence that fully confirms the correctness of a particular hypothesis. At times, the evidence is discovered unexpectedly while embarking on other studies. For instance, an unknown skull of a woolly rhinoceros was found on Mammoth Mountain in the Republic of Sakha (Yakutia) during a school expedition in 2010. Comparative analysis of fossil rhinoceroses' skulls revealed the different times in varying exposures of the Aldan River, indicating that one of the skulls of the woolly rhinoceros is distinctive from the others. Anatomical study of the skulls of woolly rhinoceroses Nos. 1, 2, 3, 4, allowed us to conclude the following:

- Nos. 1, 2, 3 have powerful, solid skulls that weigh about 10-17 kg.
- The size of skull No. 4 is smaller than the cranial boxes of the Nos. 1, 2, 3.
- The weight of skull No. 4 is 5 kg.
- Skull No. 4 has strongly pronounced cranial joints, which are absent in the other three.

- The most important point is that skull No. 4 has a narrow snout, while the others have blunt snouts.
- Skull No. 4 also revealed that the place of growth of the second horn is not expressed.
- In terms of tooth structure (size), the skull belongs to a young, mature fossil animal. This is evidenced by the large size of teeth and molars, which are at the stage of gum eruption.
- The distance between the external walls of the cheekbone is 18.02 cm, and in Nos. 1, 2, 3, it varies from 15.02 cm to 18 cm.

Relying on the works of paleontologists, who in one way or another investigated certain aspects of the description of bone remains of the woolly rhinoceros in other locations, as well as our own theoretical searches, we concluded that this skull probably belongs to another subspecies of the fossil animal. The participants of the expedition named this subspecies "Narrow-necked Rhinoceros." Consequently, the young paleontologists made a hypothesis that, at the time when the animals of the mammoth fauna flourished, there may have been some species or subspecies of woolly rhinoceros in the territory of the Paleo-Yakutia in addition to the Lena species.

To prove the existence of other species or subspecies of woolly rhinoceros, it is necessary to continue the search and research work on the study of mammoth fauna. The analysis of experimental activity of the teacher-enthusiast Petr Dmitrievich Maksimov on the organization and carrying out of school mobile expedition on paleontology in the conditions of permafrost for 48 years opens a perspective for the decision of this question. As a result, material for study was obtained. Its analysis allowed us to conclude that the discovery of traces of the ancient mammoth fauna by young researchers within the framework of the compiled expedition route on small watercrafts is a unique approach to additional education of the younger generation while organizing recreation, health improvement and employment of children during the vacation period. It enables familiarizing schoolchildren with the traditions and customs of their ancestors, learning to conduct elementary paleontological research while visiting Mammoth Mountain, fostering students' love and respect for nature and moral and civic responsibility for its prosperity through studying the flora and fauna of the Aldan River, developing young tourists' survival skills in the extreme conditions of the North.

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### The mammoth's mysterious companion: the materials of the Republican ecological and paleontological camp for schoolchildren "Tusk," years 1997–2013

O misterioso companheiro do mamute: os materiais do campo ecológico e paleontológico republicano para escolares "Tusk", anos 1997-2013

El misterioso compañero del mamut: los materiales del campamento ecológico y paleontológico republicano para los escolares "Tusk", años 1997-2013

#### Resumo

Este artigo trata de uma descoberta única. Em 2010, uma expedição escolar encontrou um crânio obscuro de um rinoceronte lanoso na Montanha Mamontova, na República de Sakha (Yakutia). Jovens paleontólogos com seu líder P. D. Maksimov conduziram um estudo anatômico do crânio fóssil do rinoceronte-lanoso. Durante todo o período (anos de 1973 a 2021) da existência do campo, jovens paleontólogos encontraram os restos de 57 fósseis animais. Todos os materiais encontrados durante as expedições foram armazenados no museu-laboratório do Campo Ecológico-Paleontológico Republicano de Crianças Escolares "Tusk". Entre os achados paleontológicos reunidos, os jovens pesquisadores foram atraídos por crânios de rinocerontes encontrados em diferentes momentos perto de várias escavações. Os participantes da expedição apresentaram a hipótese de que durante o período do florescimento da fauna de mamutes, poderia ter havido alguma espécie ou subespécie de rinocerontes lanosos no território da Paleoyakutia além da espécie Lena. Os resultados da pesquisa foram muito apreciados pelos especialistas das conferências científicas republicanas.

**Palavras-chave:** Crânio de rinoceronte lanoso. Estudo anatômico. Jovens paleontólogos. Fauna de mamutes. Campo ecológico-paleontológico de escolares "Tusk".

#### Abstract

This article deals with a unique discovery. In 2010, a school expedition found an obscure skull of a woolly rhinoceros on Mamontova Mountain in the Republic of Sakha (Yakutia). Young paleontologists with their leader P. D. Maksimov conducted an anatomical study of the woolly rhinoceros' fossil skull. During the entire period (years 1973-2021) of the camp's existence, young paleontologists have found the remains of 57 animal fossils. All the materials found during the expeditions have been stored in the museum-laboratory at the Republican Ecological-Paleontological Camp of Schoolchildren "Tusk." Among the gathered paleontological finds, the young researchers were attracted to rhinoceros skulls found at different times near various excavations. The expedition participants have put forward the hypothesis that during the period of the flourishing of the mammoth fauna, there might have been some species or subspecies of woolly rhinoceros on the territory of Paleoyakutia besides the Lena species. The results of the research were highly appreciated by the experts of the republican scientific conferences.

**Keywords:** Woolly rhinoceros skull. Anatomical study. Young paleontologists. Mammoth fauna. Ecological-paleontological camp of schoolchildren "Tusk".

#### Resumen

Este artículo trata sobre un descubrimiento único. En 2010, una expedición escolar encontró un cráneo oscuro de un rinoceronte lanudo en la montaña Mamontova en la República de Saja (Yakutia). Los paleontólogos jóvenes con su líder P. D. Maksimov llevaron a cabo un estudio anatómico del cráneo fóssil del rinoceronte lanudo. Durante todo el período (años 1973-2021) de la existencia del campamento, los jóvenes paleontólogos han encontrado los restos de 57 fósiles de animales. Todos los materiales encontrados durante las expediciones han sido almacenados en el museo-laboratorio del Campamento Ecológico-Paleontológico Republicano de Escolares "Tusk". Entre los hallazgos paleontológicos recogidos, los jóvenes investigadores se sintieron atraídos por los cráneos de rinoceronte encontrados en diferentes momentos cerca de varias excavaciones. Los participantes de la expedición han planteado la hipótesis de que durante el período del florecimiento de la fauna del mamut, podría haber habido algunas especies o subespecies de rinocerontes lanudos en el territorio de Paleoyakutia además de la especie Lena. Los resultados de la investigación fueron muy apreciados por los expertos de las conferencias científicas republicanas.

**Palabras-clave:** Cráneo de rinoceronte lanudo. Estudio anatómico. Paleontólogos jóvenes. Fauna de mamut. Campamento ecológico-paleontológico de escolares "Tusk".