Large Mammals of the Anthropogene of Yakutia

Peter A. Lazarev

Large mammals (phylogeny, taxonomy, paleoecology, faunal complexes, taphonomy, remains) Anthropogene Yakutia

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ABSTRACT

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Scientific consultant: Sc.D., Professor N.K.Vereshchagin

Officials: Member of RAS, Doctor of Biology, Professor N.G. Solomonov, Sc.D. M.A.Erbaeva, Sc.D. Y.N .Litvinov

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For further reviews of author's information, please contact: 630091, Russia, Novosibirsk, ul. Frunze 11

The thesis can be found in the library of the Institute of Systematics and Ecology of Animals

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Scientific Secretary of the Dissertation Council Sc.D., Professor C / A.Yu.Haritonov

Introduction

GENERAL DESCRIPTION OF WORK

Relevance of the topic: High abundance and diversity of anthropogenic mammals and the large number of localities of remains imply most promising research possibilities for cryozoological paleotheriology are in North Asia. In the permafrost the unique burial of corpses and skeletons of extinct animals have safely survived the mass extinction of animals in general and the excavation and study of such findings lead to the understanding of the causes of their death and burial taphonomic features. Research of hair, soft tissues, the contents of the gastrointestinal tract and other organs provide unique anatomical knowledge and exterior features of ancient mammals, identify patterns of evolutionary processes, as well as climate fluctuations and the formation of vegetation and other components of the environment. The results of these studies are essential in the study of vector evolution issues, phylogenetic relationships of modern animals with Pleistocene ancestors and their problems of survival in a changing environment of today.

One of the important aspects of the research is to highlight the validity of some new taxa and a partial revision of systematics of Anthropogene large mammals in Yakutia. The first such studies were conducted in the 19th century by I.D. Chersky (1891). Researchers have been studying extensive collections of serial osteological material since the late 1950's. This research is very important for identifying morphological variability and phylogenetic relationships for the recovery of individual groups of mammals. Systematic studies to identify the dominant forms of mammals will highlight faunal complexes corresponding to different epochs in the Anthropogene.

The purpose and objectives of the study: The aim is to study the phylogeny and paleoecology of Anthropogene large mammals in Yakutia. To achieve this goal the following objectives were identified:

- Collection of fossil remains of fossil mammal fauna through an integrated program of field research and the creation of skeletal collections;

- Selection, mapping and study support of anthropogene localities of fauna mammals;

- Searches, excavation and study of cadaveric and skeletal remains of mammals and the taphonomic conditions of graves;

- Partial revision of systematics and phylogenetic relationships of specification of individual taxa of large mammals, the identification of diagnostic features based on the analysis of morphological variability of their skeletons;

-Selection of stages of the formation of anthropogenic mammals and their associated faunal assemblages;

- Reconstruction of paleo-mammalian habitat conditions;

- Preparation of reports of morphometric materials from representative megafauna.

Scientific novelty: The author first studied and systematized a large amount of anthropogenic fossil mammal material collected within the territory of Yakutia and adjacent regions. The author recommended a partial revision of the systematic status of some anthropogenic large mammals. He proposed signs for the diagnosis of new species and subspecies.

The author identified subspecies and interspecific phylogenetic relationships among the most abundant fauna of large mammals i.e. mammoths, rhinos, horses, bison and other mammals. Then the author identified stages of formation in anthropogene and their associated faunal complexes.

Excavated in Yakutia under his direct supervision, the author provided the first results of studies of unique remains of corpses and skeletons of mammoths, woolly rhinoceros, horses, and bison. He identified stages of the most frequent death of animals in the late Pleistocene and studied taphonometric features of graves sites to give reasons for the death of animals and their conditions of preservation of soft tissues within permafrost from the past to the present. In particular, for the first time in northeast Siberia the author excavated and studied the nearly complete corpse of the Selerikanskoy pozdneneopleystotsene horse which died 37,000 years ago. This discovery was complemented by first time finds of the Lena horse in the Holocene. As a result, the author was able to conduct a comparative anatomical analysis of corpses and skeletons and propose a hypothesis about the origin of the modern horses in Yakutia pozdneneopleystotsene Lena (Equus lenensis). On the basis of palynological spectra together the author and palynologist A. I.Tomsk reconstructed the paleoenvironmental habitat of mammals at various stages of their development.

Key provisions for the defense:

1. Features of the phylogeny and stages of large mammals with relevant faunal complexes are largely attributable to changes in the nature of paleoecological habitat of the Anthropogene caused by a change to colder weather with short periods of warming and the development of glaciations and permafrost. The spread of tundra and taiga landscapes in the Pliocene and early neopleystotsene territory of Yakutia was divided into the Lena (Western Yakutia) and the Bering Sea (Eastern Yakutia) zoogeographical provinces.

2. On the basis of studying a large series of osteological material and identifying new species and subspecies based on morphological traits, a revision of some taxa and for the first time research has provided an analytical overview of the structure of the fauna of large mammals Anthropogene Yakutia.

3. The study of cadaver types, burial taphonomy, and skeletal remains of mammoths allowed for the identification of a network of natural "traps" that caused their rapid destruction. Based on radiocarbon dating, the two stages when the most common animal deaths occurred were during the Karginsky interglacial (25 - 50 thousand years) and at the end of the Sartan glaciation - the beginning of the Holocene optimum (9 - 13 thousand years).

4. As a result of cadaveric studies and skeletal remains of Pleistocene animals (mammoth, woolly rhinoceros, Lena horse, bison) details of their gastrointestinal tract provided facts regarding the appearance, anatomy and contents of internal organs which revealed morphologically expressed external adaptive features and allowed for the reconstruction of climatic conditions and vegetative nature of their habitat.

Practical Importance: Materials and research of mammals Anthropogene Yakutia can be used in the development of the study of systematics and phylogenetic relationships of mammals and anthropogenic paleogeographic reconstructions in other regions of northern Asia and North America on the basis of auditing the systematics of mammals and faunal assemblages. Also the author introduced biostratigraphic recommendations to the Geological Service of the Republic of Sakha (Yakutia) for the development of large-scale geological mapping of biostratigraphic verhnekaynozoyskih deposits and interregional correlations. And, some job positions can function to establish the continuity of evolutionary processes between the Pleistocene and modern zhivoshyh in order to promote measures for their preservation and further development.

Approbation works. Fundamentals and the results of the meeting were presented at the All-Union for Quaternary Research (Khabarovsk, 1968), at II-IV All-Union Conference on the study of mammoths and fauna (Leningrad, 1975, 1978, 1983, 1987, 1991), at the XI Congress INQUA (Moscow, 1982), at the V Congress of the Union Theriological Society (Moscow, 1990), at the International Symposium "Quaternary stratigraphy and events in Eurasia and the Pacific (Yakutsk, 1990), at the International Conference" Neogene and Quaternary mammals Paleoarctic "(Krakow, 1994) , at the 1st International Mammoth Meeting (St. Petersburg, 1995), 1st International Conference of the Northern Forum Academy "Knowledge at the service of the peoples of the North" (Yakutsk,1996), at the International Symposium on the study of fossils (Japan, 2001) and at the 3rd International Mammoth Conference in Canada (2003). The author's works are also published in the theses of the IV International Theriological Congress (Edmonton, 1985), XIII Congress INQUA (Beijing, 1991) and the 2nd International Mammoth Conference (Rotterdam, 1999). A number of papers have been published by the author in Canada, Japan, China, France, Germany and the U.S.

Publications: On the topic of the dissertation there have been published 60 papers. Among them are 10 monographs (two of them were written soley by the author and four others of which he is the main contributor). The author also published articles on user fees and procedures for the excavation of fossil remains of animals and two recommendations on paleontological substantiation of Cenozoic stratigraphy.

Structure and scope of the thesis: Dissertation is presented in 317 pages of printed text, 110 figures and 42 tables. It consists of an introduction, seven chapters, conclusions and bibliography.

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Contents

CHAPTER I MATERIALS AND METHODS OF RESEARCH

In this paper we used more than 7000 fossil bone remains collected by the author during more than 40 years of field work in Yakutia and Magadan Oblast. These materials are housed in the main osteological collections Yakut Scientific Center (YSC) and Mammoth Museum (MM) Institute of Applied Ecology of the North Academy PC (I). In addition, the author studied material stored in the PGO "Yakutsk geologiya" Northeastern Complex Research Institute (SVKNII) and Northeast Territorial Geological Survey (SVTGU) Magadan, Zoology (ZIN), Paleontology (IDUs) and Geological (GIN) RAS Institutes, local history collections, school museums and other organizations. The author managed to examine some osteological materials from the late Cenozoic in France (Museum of Natural History, Mr. Oaten), Alaska (Fairbanks University Museum) and Japan (private museum in Gifu). The study of osteological material revealed that this period is dominated by bones belonging to the representatives of three genera i.e. Mammuthus – 27.4%, Equus – 26.9% and Bison – 26.8%. The frequency of other genera are; Rangifer – 7.6%, Coelodonta – 4.9%, Alces – 2.1% and others -- 4.3%. These data seem to some extent reflect the numerical value of various types of mammals that lived in the Pliocene - Neopleistocene time. These data show a marked increase in the number of species from the Pliocene to the late Pleistocene, when mammoth fauna reached its peak. The author is a direct participant and organizer of excavation and research of many unique finds corpses and skeletons of Pleistocene mammals. The author developed a method of excavation and burial of cadaveric skeletal remains for mammoths and other representatives of the mammoth fauna, which has been approved by the Mammoth Committee chairman RAS.

We used comprehensive methods for studying complex mammalian fauna anthropogene, including not only a paleontological analysis, but also geological and stratigraphic, geomorphological, palynological, paleogeographic, taphonomic, radioactive dating, microbiological and other types of research for competent field research as indicated by the author in "Guidelines for search and study of mammoths Yakutia" (1979).

In comparative anatomical studies we used measurement techniques developed by V.I. Gromova (1949, 1950), V.O.Vitt (1934, 1952) and I.A.Dubrovo (1960). We referenced V. Eisenmann (1980) to identify morphological characters of skeletal bones when averages and extreme values of measurements and indices percentage were obtained in a large series of osteological material. The geological age of the study was placed on a new stratigraphic scale within the Quaternary approved by the MSC in 1995.

CHAPTER 2 RESEARCH HISTORY OF ANTHROPOGENIC MAMMALS IN YAKUTIA

On the findings of cadaveric and skeletal remains of mammoths in Yakutia authors at different times included P.S. Pallas (1769, 1773), J.G. Gmelin (1771), M.I. Adams (1808), A.F. Middendorf (1860), G. Maidel (1894), E.V.Toll (1897), O.F.Hertz (1902), V.V. Zalensky (1903, 1909), F.A. Bylyanitsky-Biryuli (1903), I.P.Tolmachev (1908; Tolmachoff, 1929), K. A. Vollosovich (1909, 1915), V.T. Illarionov (1940), G.A. Sarychev (1952), Yu.N. Popov (1956), J. Augusta, Z. Burian (1962), V.E. Garutt (1966), N.K. Vereshchagin (1977, 1979, 1981, 2002), V. V. Ukraintseva (1973, 1977), P.A. Lazarev (1971, 1977, 1979, 1986, 2002) and others. Among the unique remains found in Yakutia, are the world's first mammoth skeleton Adams (1799), Berezovsky (1900), Lyakhovsky (1906), Sanga-Yuryakhskoye (1908), Chekurovsky (1959), Tirehtyahsky (1970), Shandrinsky (1971), Maksunohsky (1994), Yukagir (2002), Oymyakon (2004) mammoths; Vshpoysky (1771), Kentiksky (1858), Holbuysky (1877), Churapchinsky (1972), Mamontovogorsky (1976) rhinos; horse embryo (1952) and Selerikanskaya horse in the headwaters of the Indigirka (1968). The remains of bison were found in the lower reaches of Yana (1946) upstream (1956) and downstream (1971) of the Indigirka.

A milestone in the history of research mammals Anthropogene Yakutia is the Novo-Siberian expedition of the Imperial Academy of Sciences led by Dr. A. A. Bunge and Baron E.V.Toll organized in 1885-1886. A study of the collection of the expedition produced the first major monograph. Later, I. D.Chersky (1891) in Yakutia studied neopleystotsene mammals found in Eastern Siberia. Chersky described 56 species of mammals, 25 of which occur in Yakutia.

A large collection of Pleistocene mammals collected in 1900-1903 by E. V. Toll during the Russian polar expedition on the New Siberian Islands has been studied by M.V. Pavlova (1906), including the taxonomy of the mammals ("variety", "race").

V. I. Gromova (1949), who investigated the fossil remains of Pleistocene horses of northern Siberia, proved the existence of an older fauna than previously thought. Noteworthy are conclusions about the dominant trends of disruption in the evolution of large mammals.

I.A. Dubrovo (1957, 1963) described for the first time found in Yakutia rhinoceros teeth from Dicerorhinus kirchbergensis (rhinoceros Merck), elephants (Elephas meridionalis and Parelephas wusti). She also developed the taxonomy of trogonterievyh mammoths.

In the study of the fauna of large mammals Anthropogene Yakutia E.A. Vangengeim has made a significant contribution Vangengeim (1961, 1977). She has highlighted new faunal complexes of eastern Siberia and identified previously described species in Yakutia peizvestnye, such as wolf Canis variabilis, elephant Palaeoloxodon namadicus, horse Equus sanmeniensis and two subspecies of Equus caballus (subspecies A and E).

From south Yakutia B.S.Rusanov (1968) described the mammalian fauna of early, middle and late Pleistocene. Subsequently, a number of provisions in his work were subjected to a thorough revision by A.V. Sher (1971), N.K. Vereshchagin (1977) and part A by P.A. Lazarev (1977, 1980, 1987).

A.V.Sher (1971) working in the Kolyma lowland found new species of mammals in the oldest part of the Olersky fauna, which distinguishes between early (Pliocene) and late (early Neopleistocene) types.

Study results from the Berelekhskaya cemetery mammoth residues, corpse of selerikanskoy horses and other locations in northern Yakutia have produced a number of interesting papers published by G.F. Baryshnikov (1998), G.G. Boeskorov (1998, 1999), N.K. Vereshchagin (1977, 1981), P. A. Lazarev (1977, 1980, 1987, 1999, 2002), V.V. Ukraintseva (1973, 1977, 1985), C.C. Flerov (1977) and others. These researchers conducted original research on cadaver remains, contents of the gastrointestinal tract of animals and fossil deposits containing them.

CHAPTER 3 SUPPORTING LOCATIONS OF FOSSIL MAMMALS

In Yakutia the author studied more than 70 locations of mammalian fauna, including, in this work, as described in reference 15 (Figure 7). Among the otposyatsya fossil mammal supporting locations listed are coastal outcrops of rivers and seas with the most complete stratigraphic structure and content rich in fauna. All mammal locations except Chebyda Krestovka were investigated by the author.

LOCATIONS OF PLIOCENE - EOPLEISTOCENE MAMMALIAN FAUNA

Figure 7. Map locations of mammoths in Yakutia

1. Mammoth Mountain 2. Ihenenskoe 3. Placer 4.Tandy 5. Chui 6. Chychymah 7. Sandy 8. Buotoma 9. Mohsogolloh 10. Verkhnevilyuisk 11. Nam 12. Tyalychyma 13. Chebyda 14. Delger 15. Kyzyl Cheese 16. The Lena Delta 17. Buolkalah 18. Muostakh island 19. Kuchchuguy Kegyulyur 20. Burguat 21.Timirdyah Haya 22. Emichi 23. Oldzho 24. Sartang 25. Borulya 26. Oskhordoh 27. Ulakhan Sullar 28. Rebrovo 29. Kondratyevo 30. Haptashinsky yar 31. Bigeevo 32. Kuchunnoy 33. Tasty 34. Berelekh 35. Achchygy Allaiha 36. Badyariha 37. Typhus yar 38. Mylahchyn 39. Selerikan 40. Keremesit 41. Shandrin 42. Sundrun 43. Tumus yar 44. Holy Nose 45. Rusks 46. Mountain Filippovka 47. Chersky 48. Duvanniy yar 49. Molotkovsky stone 50. Utkinsky stone 51. Constantine yar 52. Siberian 53. Krestovka 54. Eterikan 55. Zimov'e

Pliocene - Eopleistocene sediments, due to their very limited distribution, were studied sufficiently.

On the river Aldan the known reference outcrop is located at Tandy. Pliocene - Eopleistocene sand and gravel deposits opened at the base of the outcrop, where we discovered the fossil remains of Allophaiomys pliocenicus, Palaeoloxodon ex gr namadicus, Archidiskodon meridionalis, Equus sanmeniensis (Vangengeim, 1961). Pliocene - Eopleistocene bearing localities in eastern Yakutia oglozheny are on the rivers Adycha (Ulakhan Sullar), Alaseya (Tumus yar), Chukoch B. (Holy Nose) and in the lower reaches of the Kolyma (Krestovka). Geological sections from these deposits with faunal remains were studied by M.N. Alekseev (1970, 1978), O.V.Grinenko (1980), and A.V.Sher (1971), P.A. Lazarev (1987), G.G. Frolova (1982) including other locations of mammalian fauna of the early neopleystotsene. Early Pleistocene deposits are more richly saturated with bone remains of mammal fauna than Pliocene - Eopleistocene deposits. They are most common in central Yakutia and in the basins of the lower and middle reaches of the rivers Indigirka, Alaseya, Chukoch B. and Kolyma.

On the river Aldan reference location of this fauna is Tandy, and on the mouth area of the river Vilyuy (Chebyda). Remains found were of Microtus arvalis, Trogontherium cuvieri, Canis variabilis, Mammuthus trogontherii trogontherii, Dicerorhinus kirchbergensis, and Cervalces latifrons.

On the river Adycha the thick sandy bottom at Ulakhan Sullar and in the lowest level at Oskhordoh we collected mammal fauna including Equus cohemensis, Equus nordostensis, and Cervalces latifrons.

Ranneneopleystotsene fauna, Olersky complex (akanskogo horizon) are richly represented in the lower parts of the location on the river Alaseya, Tumus yar , Chukoch B, Holy Nose and on the right bank of the Kolyma River in the vicinity of Krestovka. In these sediments A.V. Sher, O.V.Grinenko and P.A. Lazarev and collected remnants of Lemmus s. obensis, Dicrostonyx renidens, Clethrionomys ex gr rutilus, Canis sp., Mammuthus sp, Equus sp., Equus (A) cohemensis, Cervalces latifrons and Soergelia.

Some reference locations for middle Pleistocene mammalian fauna in central Yakutia are the 50 meter terrace of Mammoth Mountain, Placer and Tandy on river Aldan and Nam on the river Vilyuy.

Eastern Yakutia is rich in mammal fauna of sredneneopleystotsene age and reference locations include one of the most northern localities of Haptashinsky yar on the eastern shore of Hromskoy lips, Tumus yar and Holy Nose on the Kolyma lowland and on the right bank of the Kolyma, Molotkovsky stone and Utkinsky stone.

Mestopahozhdepiya late Pleistocene mammalian fauna: Locations of late neopleystotsene fauna are ubiquitous in Yakutia. Bone bearing deposits of this age overlay all of the above levels at support locations in central and eastern Yakutia. Bone bearing localities of faunal remains of mammals are Mammoth Mountain on the river Aldan, Hinting terrace on the river Vilyuy, Berelekh "cemetery" of mammoths on the eponymous river basin of the lower reaches of the river Indigirka and Duvanniy yar on the right bank of the Kolyma. Fauna of these localities have been studied by E.A.Vangengeim (1961), B.S. Rusanov (1968), A. K. Aghajanian and A.N. Motuzko (1972), and A.V. Sher (1971), P.A. Lazarev (1980) and other scholars.

On the islands of the Arctic Ocean the locations of mammalian fauna late Pleistocene are ubiquitous.

CHAPTER 4 PHYLOGENY AND TAXONOMY OF LARGE MAMMALS OF NORTHEAST ASIA

Basis of analytical review of phylogeny and systematics of large mammal fauna Anthropogene Yakutia was the result of years of study by the author of fossil osteological material collected in the territory of Yakutia and adjacent regions. This chapter focuses on the origin and phylogeny of individual genera; describes the diagnostic morphological features of the bones of skeletons of species and subspecies, the results of comparative analysis, and presents the results of a partial revision of some taxa of mammals of the Anthropogene Yakutia. Also shown are the locations of fossils of large mammal habitats and their chronology (Table 10). In the abstract an abbreviated version of the descriptions of taxa is present.

Table 10

STRATIGRAPHIC UNITS:

Holocene

Sartan

Karginsky

Zyransky

Kasantsevo

Tazovskny

Messovsko-shirtiisky

Samarovsky

Tobolsk

Yakansky

Chukochinskii

LARGE MAMMALS OF THE ANTHROPOGENE OF YAKUTIA

4.1. Order Carnivora

In Yakutia during Pliocene - Neopleistocene time members of the families Canidae, Ursidae, Mustelidae, and Felidae existed. Predators in the late Pleistocene were the most widespread group.

Family Canidae Gray 1821 – Genus Xenocyon Kretzoi 1938

Xenocyon lycaonoides Kretzoi 1938. Xenocyon remains were found in the river valleys Lena, B. Adycha and Chukchi. This canid is associated with small wolves and differs from large size canids close to the modern wolf (Sotnikov, 1978, 1989). This canid lived in the late Pliocene - Pleistocene.

Genus Canis Linnaeus 1758 - Wolves

The ancient wolf Canis variabilis was discovered and described in central Yakutia (Vangengeim, 1961). These wolf remains have uncertain taxonomic status in the oldest recorded Olersky fauna of eastern Yakutia (Sher, 1971). We found the skull of pozdneneopleystotsene canines on the river Alaseya with distinct frontal ridges, but unlike this wolf their sizes are smaller. Their systematic position can only be determined after additional research.

Canis variabilis Pei 1934. The lower jaw of this wolf with a broken ascending ramus was found in sediments from the ranneneopleystotsene Tandy location on the river Aldan and was also described by E.A.Vangengeim. Morphologically it is similar to that of C. variabilis, but, for example, it has a fovea masticatory muscle with deeper body height under more teeth.

Canis lupus Linnaeus 1758. Skulls of the pozdneneopleystotsene wolves of Yakutia morphologically differ little from those of the west Siberian and European locations. In the late neopleystotsene this wolf was ubiquitous in Eurasia and North America.

Family Ursidae Gray 1825

Species Ursus arctos Linnaeus 1758 – Brown bear

Ursus arctos Linnaeus 1758. Finds of this fossil brown bear in Yakutia are rare due to constraints on distribution. In the ancient Pleistocene ranneneopleystotsene Olersky Formation sediments have marked residues of bear (Sher, 1971), especially large numbers of lower jaws with teeth (№ 4967, collection YSC) from the river Adycha. These lower jaws have a characteristic base with direct, high location of articular condyles, and mandibles with a considerable tooth height. When additional material is available it may suggest a new subspecies from the sredneneopleystotsene age, although the late Pleistocene brown bear in its size is not significantly different from modern Ursus arctos L.

Family Mustelidae Fisher 1817 - Genus Gulo Storr 1780 - wolverine

Ancient Pliocene - ranneneopleystotsene wolverines were first described by M.B. Coihhko (1978, 1982) who believed that northeast Asia (the Pliocene had a moderately cold climate and the peculiar environmental conditions) was a hotbed for the origin of Gulo. In the Gulo phylogenetic line G. minor evolved to G. schlössen and G. gulo.

Gulo minor was described in 1982 as a new species. M.V.Sotnikova (1982) identified G. minor from lower mandible branches from the Sullar Ulakhan location on the river Adycha. The lower jaw is characterized by small size, narrow elongated premolar teeth and some other morphological features. Geological age is Pliocene.

Gulo schlössen Kormos 1914. Detail of a lower jaw from this wolverine was recovered from the Krestovka outcrop in lower reaches of the Kolyma and was described by M.V. Sotnikova (1978). Geological age is early Neopleistocene.

Gulo gulo Linnaeus 1758. In Yakutia fossil remains of wolverines are very rare. At the Berelekhskaya cemetery in 1970 the dilapidated corpse and skeleton of an adult wolverine was excavated which by size and morphological features is close in exterior size to modern wolverines (Vereshchagin, 1977). However, bones and skeleton of wolverines in Yakutia are relatively large in size.

Family Felidae Gray 1821 – Genus Homotherium Fabrini 1890 - sabre tooth cats

Homotherium sp.1978. Only a single bone of this ancient predator the lower end of the humerus has been found on the right bank of the river Adycha at the Sullar Kyra outcrop. This was described by M.V.Sotnikova (1978). Judging by the specimen small size, this refers to the later form of Homotherium with a geological age of early Neopleistocene.

Genus Panthera Oken 1816 - large cats

The late Pliocene Olersky fauna of eastern Yakutia is noted by the presence of Felis spelaea (Goer, 1971). On the basis of analysis of a large amount of lion osteological material N.K. Vereshchagin (1971) described the Yakutia lion as a distinct kind of Panthera (Leo) spelaea, different than the lion common throughout Eurasia and North America.

The modern lion cave lion of Yakutia has a much longer and narrow skull and a relatively short dentition. Bones of the skeleton suggests that in size they were inferior to European lions and were much smaller than North American cave lions Panthera (Leo) atrox Leidy. Cave lion in Yakutia were almost ubiquitous.

Genus Felis Linnaeus 1758 - small cats

Felis (Lynx) lynx Linnaeus 1758. We studied the lower jaw (№ 4028, collection YSC) from the river Large Kuropatochya, a tributary to the East Siberian Sea. Pozdneneopleystotsene lynx survived without significant modifications until modern times. Apparently, its habitat in the late Pleistocene was the taiga zone.

4.2. Order Proboscidea - Family Elephantidae Gray 1821 - elephants

Yakutia elephants existed within three genera i.e. Archidiskodon, Mammuthus and Palaeoloxodon. However one should bear in mind that the findings and residues of Archidiskodon and Palaeoloxodon in Yakutia are rare. Elephant evolved in Eurasia from the Archidiskodon – Mammuthus phylogenetic line.

Genus Archidiskodon Pohlig 1885

I.A. Dubrovo (1953,1957,1960,1964,1966,1977) came to the conclusion as a result of an audit of elephant systematics that the Archidiskodon elephants were represented by three subspecies in Yakutia.

Archidiskodon meridionalis meridionalis Nesti 1825. This subspecies of Yakutia was described by I.A. Dubrovo (1963) using the upper left tooth Pd4 (№ 731, collection IDUs), found on the bank of the river Vilyuy near the estuary Chebyda. I.A.Dubrovo kindly provided this tooth to the author which had the well marked signs of this species i.e. total number of plates was 7, the thickness of the enamel an average of 3 mm and frequency 6 to10 cm. From the Kolyma lowland of the river Chukoch B. A.V. Sher (1971) described several teeth from elephants Archidiskodon and Mammuthus sp. in central Yakutia. A. m. meridionalis penetrated Yakutia in the late Pliocene and judging by a rare find here had limited distribution.

Genus Mammuthus Burnett 1830

Genus Mammuthus, as mentioned above, is a sequel of sorts in the phylogeny of Archidiskodon. In Yakutia the species M. trogontherii Pohlig lived in the first half of the Pleistocene and M. primigenius in the second half of the Pleistocene. Systematics of the genus Mammuthus still remains controversial.

Mammuthus trogontherii Pohlig 1889

I. A. Dubrovo (1977) held the view that the audit confused the taxonomy of trogonterievyh mammoths, which included the ancient elephant genus Mammuthus. The results of our studies using materials from Yakutia confirmed the validity of this approach. Trogonterievy mammoths included subspecies M. trogontherii trogontherii and M.trogontherii chosaricus, which lived in the early Pleistocene and in the first half of the middle Pleistocene respectively.

Mammuthus trogontherii trogontherii Pohlig 1889. We have studied a large number of molars of Mammuthus trogontherii trogontherii (collection YSC) from locations on the rivers Aldan, Adycha and Alaseya. A characteristic feature is their narrow crown on the molars, and the number of plates 17, frequency of 10 cm plates at 5.5 - 6.5. This mammoth was common in northern Eurasia.

Mammuthus trogontherii chosaricus Dubrovo 1966. Of the characteristic features of this mammoth can be noted up to 23 plates at the last native molar tooth with frequency of plates 6 - 7, enamel thickness from 1.6 to 3.0 and a well-defined median expansion. In the first half of the middle Pleistocene this mammoth lived across almost all of Eurasia.

Mammuthus primigenius Blumenbach 1799 - mammoth

The taxonomy of species Mammuthus required revision, as had previously allocated forms and names "early type" and "late style" (Vangengeim, 1961) were inadequate. These names do not match the standard zoological nomenclature, and cannot be recognized as taxa. They actually represent subspecies of Mammuthus. In order to streamline the taxonomic status of these forms we offer two subspecies viz., Mammuthus primigenius primigenius Blumenbach and Mammuthus primigenius sibiricus Blumenbach, which lived in the second half, middle - early late Pleistocene (Kasantsev epoch) and a significant part of the late Pleistocene respectively (Zyransky - Sartan epoch). We preferred the late subspecies name ‘sibiricus’, which was previously used by some researchers (Deperet and Mayet, 1923, Gromova, 1965, Averyanov and Abrams, 1991).

Mammuthus primigenius primigenius Blumenbach. Because this subspecies is described by the new title Mammuthus pr. primigenius, we describe the characteristic of the subspecies of the skull with the teeth from a 15 meter terrace CFMA, right tributary of the river Lena stored in the collection of the Yakut State Museum of Northern Peoples, Yaroslavl (YAGMINS). The skull has large sized molars relatively wide (78 - 107 mm) with an average length of 260 - 270 mm. In the last native molar tooth, plates number from 16 to 25, the frequency of 10 cm plates 7.5 – 9 and the thickness of enamel 1 - 2 to 8 mm. M. pr. primigenius was distributed much wider than M. tr. chosaricus.

Mammuthus primigenius sibiricus Blumenbach 1799. This late mammoth evolved from its parent M. pr. primigenius and differs, in particular, with a large number of plates on the last molars (the average number of plates 20 to 23), their greater 10 cm frequency (10 versus 8 to10) and with thin enamel. This subspecies was widespread throughout northern Eurasia, but the most numerous population of this subspecies lived in cold tundra-steppe areas north of Yakutia.

4.3 Order Perissodactyla - Family Rhinocerotidae Owen 1845 - rhinoceros

In Yakutia Dicerorhinus and Coelodonta are represented.

Genus Dicerorhinus Gloger 1841

Described species is Dicerorhinus kirchbergensis which lived during the early Pleistocene.

Dicerorhinus kirchbergensis Jaeger 1839 - Merck's rhinoceros

Left upper teeth P4 and M2 were found in the outcrop Chebyda on the left bank Vilyuy in early Pleistocene sediments and described by I.A. Dubrovo (1957). Teeth were well developed with a collar on the inner wall and a flattened, bottom middle. As finds of this rhino are rare, facts about its habitat are difficult to judge. In Yakutia, kirchbergensis lived in the early Pleistocene.

Genus Coelodonta Bronn 1831 – woolly rhinoceros

In Yakutia Coelodonta antiquitatis with subspecies C.a. jacuticus and C.a. antiquitatis are present, both of which lived in the middle and late Pleistocene.

Coelodonta antiquitatis jacuticus Rusanov 1968. Bone remains of this rhinoceros found in limited quantities in the entire territory of Yakutia. An example is skull Number 311 (collection YSC), extracted from the middle Pleistocene alluvial sands, 50 meter terrace from the river Aldan at Mammoth Mountain. This specimen has all the diagnostic features inherent in this rhino with a skull of large size, massive, with a characteristic highly elongated parietal bone and a small angle (22°) with respect to bending of the fronto-nasal surface.

Coelodonta antiquitatis antiquitatis Blumenbach 1799. Remains of woolly rhinoceros in Yakutia are ubiquitous. The author studied the Churapchinsky specimen (a complete skeleton of a woolly rhinoceros) and a large part of the skeleton of a young rhino extracted from the loam of the 80 meter terrace of the river Aldan at Mammoth Mountain. Dimensions of the skull of this specimen are much smaller than in the Yakut subspecies but are also typical for the skull i.e. short parietal bone and a large angle of bend behind the frontal horns. Unlike ancient subspecies the base of the mandible is curved, and incisor portion is much wider.

Family Equidae Gray 1821 - Genus horse Equus Linnaeus 1758 – horses - Subgenus Allohippus Kretzoi 1938

The Subgenus Allohippus in central Yakutia includes Equus (A) ex gr. sanmeniensis, which was described by E. A.Vangengeim (1961) from bone remains collected from the east side of river Aldan. In Yakutia the eopleystotsene population of horses was introduced by A.V.Sher (1971). Also, at the beginning of the early Pleistocene there existed a very peculiar horse Equus (A) coliemensis Lazarev (1980).

Equus (Allohippus) verae A.V.Sher 1971. This horse is distinguished by its giant size as noted in the skull and postcranial skeleton. The upper molars are well expressed in the form of archaic features with strongly folded enamels providing a chewing surface and short protocone.

Equus (Allohippus) coliemensis P.A.Lazarev 1980. This type of horse has been isolated by the author based on the holotype skull number 1741 (collection YSC) with a well preserved row of teeth. Found in Quaternary sediments on the bank of Chukoch B the skull is bullheaded with elongated front portion and the characteristic narrow occiput. The teeth are relatively small, the protocone on the upper molars subtreugolnoy have a shape with a short upper lobe.

Subgenus Equus Linnaeus 1758 - the real horse

Since the second half of the early Pleistocene in Yakutia there existed two separate species of horse viz., E. nordostensis and E. orientalis lenensis, representing one phylogenetic line.

Equus nordostensis Rusanov 1968. This form was originally described by B.S. Rusanov (1968) as a subspecies of caballoid horse. Later, as a result of the additional material it was declared an independent species i.e. E. nordostensis (Lazarev, 1980). This horse has a skull of large size with upper molars which have weak brand folding and elongated protocone.

Equus orientalis Rusanov 1968. Sredneneopleystotsene horse, as previously described by B.S. Rusanov as the subspecies E. caballus orientalis, later we reimplemented it as a separate species. It has a large skull with elongated dlinnomordy dentition, flattened protocone and has folds on the upper molars.

Equus lenensis Rusanov 1968. The Lena horse was elevated to the rank of species by N.K.Vereshchagin and P.A.Lazarev (1977). This horse had a bullheaded skull of small size with long protocone on the upper molars.

There was speculation that E. lenensis is close to the North American horse E. lambei (Hay, 1917). Perhaps they even represent the same species. On the basis of personal inspection of skulls and other osteological materials in the museums of the cities of Whitehorse, Dawson (Canada) and Fairbanks (USA) the author found that the Lena horse was significantly larger and heavier than E. lambei.

4.4 Order Artiodactyla - Family Cervidae Gray, 1821 – the deer family

In Yakutia during the late Cenozoic the following genera existed: Cervus, Cervalces, Alces, and Rangifer. Phylogeny and taxonomy of the deer family in Eurasia has been studied in detail by I.A.Vislobokova (1990). Bone remains of deer compared to those of mammoth, bison and horses are much rarer.

Genus Cervus Linnaeus 1758 - real reindeer

Remains of the genus Cervus in northeast Asia are relatively rare.

Cervus elaphus Linnaeus 1758. The best preserved skull splichayutsya number 2192 and horn number 3231 (collection YSC), were found in the vicinity of Duvanniy yar downstream on the river Kolyma. These skulls have large sizes with a broad cranium. Antlers are very large and massive. Cervus elaphus in the late neopleystotsene was larger than the modern Yakutia form and it is widespread in the late Pleistocene and Holocene but preserved only in the southwestern regions.

Genus Cervalces Scott 1885 - elk

Cervalces latifrons Johnson 1874. Regulation of elk in the taxonomy has long been debated. His first attributed to the genus Alces (Alces latifrons) and only in recent years have been attributed to the genus Cervalces. Judging by the size of antlers, it was a very large animal. In the early Pleistocene this animal was common in central Yakutia and in the Yana river basin.

Cervalces latifrons postremus (Vangengeim, Flerov,1965). C. latifrons postremus was distributed in the middle and early - late neopleystotsene in the taiga zone of central Yakutia and basins of the northern rivers. This elk was much larger than the modern elk.

Genus Alces Gray 1821 - moose

In Yakutia the present form is Alces alces L. Although the question of the origin of the genus Alces is considered open, the presence of a number of animals with similar features does not preclude the validity of assumptions about finding the origin of Cervalces and Alces in a single phylogenetic line.

Alces alces Linnaeus 1758. A. alces has a trunk, antlers and limb bones that are significantly shorter and thinner than those of Cervalces latifrons postremus. Alces alces from the late Pleistocene to the present day remained without significant changes. This moose in the late Pleistocene and Holocene extended over the whole territory of Yakutia.

Genus Rangifer H. Smith 1827 - caribou

In the northeast part of Yakutia Olersky fauna individual remains of Rangifer sp. (Sher, 1971) are noted.

Rangifer tarandus Linnaeus 1758. Skeletal remains of caribou are found everywhere in Yakutia. In the late neopleystotsene rasprosgranen reindeer ranged across the north of Eurasia and survived today without significant changes of the skull and skeleton.

Family Bovidae Gray 1821 – Genus Bison H. Smith 1827 - bison

C.C. Flerov (1976, 1977) examined the mylahchynskogo bison (North Yakutia, 1971) and osteological material from North America. Flerov determined the bison of northeast Asia included Bison priscus crassicornis Richardson (Neopleistocene) and Bison priscus occidentalis Lucas (late Pleistocene).

Bison priscus crassicornis Richardson 1854. The skull of this form has a large wide prominent forehead and long horns. The skull and bones of the extremities have well expressed signs of sexual dimorphism. In general this Pleistocene bison was distributed from Asia to North America via the Bering land bridge.

Bison priscus occidentalis Lucas 1898. Remains of this form of Korogih pozdneneopleystotsene buffalo are numerous throughout Yakutia. It is much smaller than its sredneneopleystotsene predecessor. Horns are short with a relatively narrow and slightly convex forehead. B. priscus occidentalis was distributed east of river Yenisei and in North America.

Genus Saiga Gray 1843 - saiga

Current form of Saiga tatarica with subspecies S. t. borealis and S. t. tatarica (Baryshnikov, Dmitriev et al, 1998).

Saiga tatarica borealis Chersky 1876. This form has archaic features of the skull compared to the current S. t. tatarica and can be identified by a small slope of the surface of the parietal bone with respect to the fronto-nasal and has slightly recurved horny rods. In the late Pleistocene this form spread across northern Eurasia and Alaska.

Genus Praeovibos Straudinger 1908 - primitive musk ox

In Yakutia in the late Eopleistocene this peculiar species of this genus lived (Sher, 1971).

Praeovibos beringiensis Sher 1971. This ancient musk ox had short, massive horns and the bottom tip reaches the base of the skull. Brain skull is very narrow and dropped down in this early neopleystotsene form that lived in the Kolyma lowland and apparently in Chukotka.

Genus Ovibos Blainville 1816 – musk oxen

Judging from fossil materials we have recovered, this subspecies (O.moschatus pallantis) lived in the late Pleistocene.

Ovibos moschatus pallantis H. Smith 1827. A well preserved skull with number 3681 (collection YSC) is from Haptashinskogo yar Hromskoy lips. The upper edge of the orbits is located above the frontal part of the skull. The cranium has a concave surface and the molar length is much longer than premolars. In Yakutia, the musk ox was supposedly extinct in the first half of the Holocene.

Genus Ovis Linnaeus 1758 – sheep - Subgenus Pachyceros V. Gromova 1936

Ovis (Pachyceros) nivicola Eschoholtz 1839 - bighorn sheep

This is one of the animals which overcame extinction in the late Pleistocene and have survived unchanged to the present. In the late Pleistocene this animal was common in the tableland and mountainous regions of eastern Yakutia.

Genus Soergelia Schaub 1952 – primitive musk ox relative

Bone remains of Soergelia in Yakutia are extremely rare. On their morphological features we can judge only from the skull number 7779 (collection MW) found in the sediment at the early neopleystotsene location Ulakhan Sullar in the lower reaches of the river Adycha. The skull is massive with a large cranium.

CHAPTER 5 PALEOECOLOGICAL SETTING, STAGES OF FORMATION AND SOME LIFESTYLE FEATURES OF LARGE MAMMALS IN THE QUATERNARY

History of mammalian development is largely due to their environment and changes in the nature of paleoecological conditions. The anthropogenic and paleoecological history of Yakutia abounded with various natural events, strong cooling and warming climate, mountain - valley glaciation, the formation of permafrost, transgressions and regressions of sea and tide. Given the changes of paleoecological habitat conditions, composition of the large mammalian fauna existed in five main stages viz., Pliocene - Eopleistocene, ranneneopleystotsene, sredneneopleystotsene, pozdneneopleystotsene and modern. Each of these stages corresponds to an original faunal complex. Reference locations in the territory of Yakutia

during the early stage of the development of mammalian fauna were divided into two zoogeographic zones; the Lena province (Western Yakutia) and the Bering Sea (Eastern Yakutia). The dividing line between the provinces is a zoogeographic boundary, which has a strip width of 300 km. It is formed by the rivers Lena and Aldan and the highland systems of the Verkhoyansk Range and Sette-Daban ridge. The presence of this boundary was first pointed out by M.A. Mensbir (1914).These provinces are characterized by excellent landscape and ecological habitat conditions for mammals. Ancient mammal fauna in the Lena province basically were part of the Siberian fauna, but in its formation some migrants attracted participants from more southern regions of Asia. In the history of mammals the Bering Sea province played a decisive role. The extensive territory of Beringia (connecting Asia with America) was to become a hotbed of subarctic theriofauna formation although it should be emphasized that the mammalian fauna of these provinces had significant differences in the early stages of their formation during the Eopleistocene and early Pleistocene.

In the paleoecological reconstruction of mammal habitat and conditions at different stages of their formation the author used materials and publications of palynologists, paleobotanists M.V. Barkova (1971), T.D. Boyarskaya (1967), R.E. Giterman (1966, 1963), M.N. Karavayeva (1948, 1955, 1958), Yu.A. Lavrushkin (1961), A.I. Tomsk (1981,1985, 2000), V.V. Ukraintseva (1978, 1985, 1988), etc.

The ancient Pliocene - Eopleistocene stage of formation of mammalian fauna occurred during a lifting of the earth's surface above sea level, which resulted and formed in the north a vast expanse of land that covered the New Siberian Islands and the whole of northern North America. The existing ecological environment had a predominance of grass and shrub fodder plants, which apparently favored animals of giant size inhabiting the vast plains. For example, the height of Equus (A) verae (calculated over the bones of the extremities at the withers) were impressive dimensions reaching 1.7 - 1.8 m and the southern elephant Archidiskodon meridionalis was an animal of giant size approaching 4 m in height.

Farther south in the area of the coastal lowland from the Yana to the Kolyma were common larch and birch forests with an admixture of pine and spruce. In the palynological complex from the Pliocene tree pollen significantly prevailed over pollen from shrubs and grasses.

In the future the climate became moderate with an average temperature of about 0 - 2 ° C in the north and up to +3 ° C in central Yakutia. Under the influence of climate cooling in the late Pliocene temnohvoynys forest relicts and broadleaf forests are retreating to the south. The palynocomplex for this time consisted of the characteristic dark coniferous hemlock, spruce, and Siberian cedar. By the end of the late Pliocene vegetation cover has increased the proportion of grass and shrubs with primary development of mountain ash, clove and goosefoot. These palynological complexes are particularly well identified in sediment samples in the Ulakhan Sullar age - location downstream on the river Adycha. Later, strong cooling caused by the formation of the Kolyma lowland hypoarctic belt - hearth formed Holarctic mammalian fauna. In the footsteps of the Pliocene - Eopleistocene cryogenic processes, sediments in northern Yakutia experienced the formation of permafrost.

In western Yakutia E.A.Vangengeim (1961) identified the Aldan faunal complex corresponding to the Pliocene - Eopleistocene stage of the formation of large mammal fauna. Reference location of this faunal assemblage is the Tandy outcrop on the river Aldan, which is opened to lower ozhelsznennye sand and pebble bone bearing deposits. Representatives of the Aldan complex are Canis variabilis, Palaeoloxodon ex gr namadicus and Equus ex gr. sanmeniensis.

The Bering province analogue to the Aldan complex is the Olersky complex representing fauna mammals of thenizhneolerskoy subsuite (chukochin horizon) of Eopleistocene age (Sher, 1971). The reference location for Olersky fauna is Holy Nose located in the Kolyma lowland in the middle district of Large Chukchi. The composition of Olersky

fauna includes Praedicrostonyx compitalis, Allophaiomys sp., Archidiskodon sp., Equus (Allohippus) verae, Praeovibos beringiensis and Soergelia sp.

Under the influence of environmental conditions and habitat the large mammals at that time differed by relatively large size, short fur coats, and a kind of primitive structure of the teeth. For example, an immigrant from North America, Equus A. verae had gigantic dimensions and the Southern elephant Archidiskodon meridionalis had narrow nizkokoronkovye teeth with a rare frequency of plates.

In early neopleystotsene judging by palynological materials there continued a further cooling of the climate and degradation and retreat south of thermophilic plant forms. At the beginning of the early Pleistocene due to sea regression climate conditions in the north become more hypoarctic. At this time Beringia reaches its maximum size connecting Northeast Asia and North America, is covered [as seen from palynoassemblages identified in early Pleistocene sediments at localities of the rivers Aldan (Mammoth Mountain), Omoloy (Timirdyah Khaya), Adycha (Ulakhan Sullar), Alaseya (MAST), and Colima (Chersky)] in vegetation with widely developed shrubs, strengthening the role of meadow and marsh associations which act as a hearth forming Holarctic mammalian fauna. In the south were common coniferous leaved forests of pine and larch. In the north the average annual temperature is lowered to - 3 - 4 ° C. Central Yakutia is dominated by coniferous and deciduous forests with some deciduous species such as oak, hornbeam and elm. The average annual temperature is still kept at + 2 - 3 ° C. Further cooling of the climate has strengthened the process of forming the cryolithozone southern boundary, which comes to the Arctic Circle.

Changing environmental conditions of habitat toward colder climate resulted in the formation of new forms of mammals, degradation of their size, changes in the structure of the dental system, thickening of the skin and the appearance of a thick coat. Nevertheless, the climate was much warmer and wetter than it is now. Using osteological data the most common mammals of the ranneneopleystotsene mhoi ochislennymi were horses. In the north their favored habitat was open space meadow and forest. Typical inhabitants of open meadow-steppe and forest spaces were trogontherii mammoth, ancient Merck's rhinoceros, bullheaded moose, caribou, Soergelia, and musk ox.

Early Pleistocene mammals in the Lena zoogeographical province were Vilyuiskaya fauna, first described by I.A. Dubrovo (1957). This faunal complex includes Mammuthus trogontherii trogontherii, Dicerorhinus kirchbergensis, Equus nordostensis, and Cervalces latifrons. The Chebyda reference location is situated on the left bank of the river Vilyuy below the mouth of Chebyda and was described by M.N. Alekseev (1961). Early Pleistocene fauna is also found in the sediments of Tallinn base outcrops in lower reaches of the Aldan and Lena River Delta.

From the early Pleistocene in east Yakutia the Sullarskny faunal complex is identified. Typical representatives of sullarskoy fauna are Dicrostonyx renidens, Microtus sp, Mammuthus trogontherii trogontherii, Equus A. coliemensis, Equus nordostensis, Cervalces latifrons, Soergelia, as well as rodents Lemmus s. obensis, Dicrostonyx renidens and Cletrionomys ex gr rutilus. All large mammals have already been exposed in the obmelchaniya process. However there are new species with characteristic and peculiar diagnostic features. The Kolyma horse with small teeth and protocone of subtreugolnoy form was dedicated by the author for its size. This horse was smaller than the large northeastern horse Equus A. verae and differed from caballoid forms. The reference location of this faunal assemblage is Ulakhan Sullar located in the lower reaches of the river Adycha (tributary Yana).

During the sredneneopleystotsene stage in the history of the formation of mammalian fauna was marked by intensification of climate cooling and the development of powerful glaciations inn the north. The climate in central and south Yakutia becomes temperate cold. Throughout the four stages at each era climate and ecology are replaced: warm Tobolsk, cold and wet Samarovo maximum glaciation, short warm Messovskoe interglacial and small Taz glaciation with particularly ambitious Zapadpoy glaciation in Yakutia, which covered almost the entire area of the central Siberian Plateau displacing

faunal mammals. On the south and east the glaciation in eastern Yakutia had gornodolinny character and did not have much impact on the lives of animals. These vytespyalis glaciers of mountain river valleys Osobenpo were extensive glaciers slipping down from the valleys of the western slopes of the Verkhoyansk Range. In the lower reaches these glaciers blocked the river valley of the Lena, moving it to the west direction. Meanwhile, during the Pleistocene permafrost generally moves south and covers a large part of the territory of Yakutia.

Vegetation throughout the middle Pleistocene had undergone significant change in the direction of the depletion of "thermophilic" forms and broad-leaved species disappear from the entire territory of Yakutia.

Particularly favorable conditions for animals existed in preglacial Tobolsk time when the vegetation was dominated by birch and larch forests with a well developed shrub undergrowth and in open spaces of the north grew and developed thick stands of larch-birch forests and heather. On the northern seashores shrub-grass associations and swampy meadows developed in the second half of the middle Pleistocene. In northern Yakutia widely developed tundra-steppe with grasses are predominant. At that time central and south Yakutia were dominated by dark coniferous larch and birch-larch forests with areas of open meadow spaces. In the undergrowth of forests grew alder, mountain ash, rose hip and Siberian juniper, which is an essential part of the diet of large herbivorous mammoths.

Beginning in the middle Pleistocene, the fauna of large mammals in the Lena - Bering zoogeographical provinces are not particularly different. The most active bond between faunas of these provinces was carried out through the low mountain ranges in the north: Kharaulakh and Verkhoyznye. The mammalian fauna in the late middle Pleistocene of western Yakutia were described by M.N. Alekseev (1961) and E.A.Vangengeim (1961) as an early version of rassamatrivalas mammoth fauna. B.S.Rusanov allocated it within the bayaginsky complex in eastern Yakutia. A.V.Sher described the faunal layers as utkinskih. We offer this nomenclature nationwide for both zoogeographic provinces i.e. the sredneneopleystotsene complex of east Siberia because the mammoth complex or mammoth fauna complex is characteristic only of the late Pleistocene. The reference location for this complex, we have allocated 50 meter terrace of Mammoth Mountain in the lower reaches of the river Aldan. Inclusive species in the eastern portion of the Siberian faunal complex were; Mammuthus primigenius primigenius, Coelodonta antiquitatis jacuticus, Equus orientalis, Bison priscus crassicornis, and Cervalces latifrons postremus. Due to the increasing cooling of climate, vegetation changes, mammals acquire adaptive characters i.e. shrinking in size, covering with thick hair layers, and changes to the structure of teeth. We see the increased number of teeth in mammoths and frequency of plates, and in horses the folds of enamel on the teeth become rare with elongated protocone etc.

During the pozdneneopleystotsene stage amid a general cooling was also recorded four climatic and ecological eras: Kazantsevo warm, Zyransky glaciations, Karginsky warm interglacial and Sartan glacial. The Sartan glaciation had a different cold and humid climate with increased precipitation and a reduction of forest areas, the development of tundra-steppe and tundra landscapes and lush grasses. These landscapes lasting in the north contained a significant amount of nutrients and so attracted the attention of the mammoth and other contemporaries in the cool summer. The mammoth fauna preferred to feed on the open meadow-steppe spaces, periglacial areas and in river valleys when winter came where snow preserved the green forage. During the Karginsky interglacial epoch the continental climate conditions were marked with dry and hot summers. At this time (25 - 45 thousand years ago) there is a wide network of natural "traps" and the death of many animals occurs and their corpses remain in permafrost to survive until the present. Despite deteriorating climatic conditions occurrring across the continent the mammoth fauna reaches its peak in the late Pleistocene. This is evidenced by the almost universal dispersal of numerous burials and occasional cadaver and bone remains of mammals.

Mountain-valley glaciation that swept highland areas have little effect on large mammals. In the late Pleistocene the permafrost zone covers the entire territory of Yakutia. Mammals during the Pleistocene acquire different features which are adaptations to changes in environmental conditions. In particular in the process of adaptation to the cold climate in mammoth the skin thickens (up to 2 cm), hair is elongated (1 m) and increases the length of the fluffy undercoat to (20 - 30 cm) and the size of the ear reduces.

At the end of the late Sartan glaciations (which lasted about 25,000 years) begins the Holocene climatic optimum, which is associated with the extinction in northeastern Asia of the most numerous representatives of the mammoth fauna. There are different versions of the causes of extinction of mammoths and some of its satellites. Some authors have always considered that primitive man as a hunter, destroyed the mammoth fauna and other authors tend to explain this phenomenon by natural disasters. This author is of the opinion that the extinction of mammoths, bison, and other representatives of the mammoth fauna is due to a sharp warming and related environmental change in habitat conditions (composition of plant foods) and other components such as the rapid development of thermokarst and swamping of vast plains. Species adapted to the cold climate such as heavy woolly mammoth with a thick skin, many ungulates and some other representatives of the mammoth fauna could not adapt to the changing environmental conditions of habitat and thus were doomed to extinction. Their extinction occurred gradually over several millennia (about 9 - 12 thousand years ago).

The late Pleistocene formed as a single event for the entire northeastern Siberian mammoth complex consisting of Dicrostonyx torquatus, Canis lupus, Gulo gulo, Panthera (Leo) spelaea, Mammuthus primigenius sibiricus, Coelodonta antiquitatis antiquitatis, Equus lenensis, Bison priscus occidentalis, Ovibos moschatus pallantis, Alces alces, Cervus elaphus and Rangifer tarandus. The reference location for the Mammoth complex, we propose the exposure of Duvanniy yar downstream on the river Kolyma. In bedrock and along the shoreline of this exposure were found numerous remains of various mammals in an excellent state of their preservation, in particular, a piece of skin of the woolly rhinoceros (absolute age 30,500 years), a gopher with the remnants of manure, buffalo wool and the skull of cave lion. At the end of the late Pleistocene – early Holocene in Yakutia bone bearing deposits of extinct Panthera (Leo) spelaea, Mammuthus primigenius sibiricus, Coelodonta antiquitatis antiquitatis, Bison priscus occidentalis, Saiga tatarica borealis appeared everywhere on the banks of rivers, lakes and the sea coast. The results of studies of cadaveric remains and palaeoenvironmental conditions allow us to reconstruct the appearance of these extinct animals and describe their way of life.

The mammoth is a large herd animal of the elephant family. The animal's body height at the withers reached 3 - 4 m and weight of 5 - 6 tons. The mammoth was covered with thick and reddish-brown long hair. It should be noted that the hair of calves and young individuals was pale yellow. Skin to 2 cm thick and long hair with a thick soft undercoat protects the mammoth from even the most severe frosts. Tusks are incisor teeth in the process of evolution that have over developed. In older individuals tusks reach 4 m to a weight of over 100 kg and grew throughout their lives, but at a faster rate in the younger animals.

As herbivores mammoth ate about 200 - 300 kg of grass forage per day. Mammoth often browsed shrubs and branches of larch trees. Fecundity of mammoth compared to modern elephants, was very low, and they may have reached sexual maturity at 11 to 15 years. Despite the finds of cadaver remains of mammoths, we are unable to fully restore the appearance of these animals.

Woolly rhinoceros lived in Yakutia at the same time with mammoth and other animals of the Ice Age. In contrast to the mammoth the woolly rhinoceros lived alone or in small families, and the number was much lower. The rhino was the second largest animal after the mammoth, its height at the withers reached 1.8 m, body length up to 3.5 m, and on the head two horns, the front horn being longer. The horn consisted not of horny substance, but of tightly cemented hair fibers. Due to this structure, the horns had a very high strength. On the feet were three appendages with horny hoofs. Woolly rhinoceros was well adapted to the cold climate, thick skinned, with thick soft fur, pale yellow, up to 15 - 20

cm in length with enough fat accumulation. The woolly rhinoceros ate grass and shrub vegetation. In contrast to the mammoth, woolly rhinoceros never migrated to the American continent through the Bering land (bridge).

Bison in the Pleistocene was widely distributed in the northeast of Asia. In the late Pleistocene the korotkorogy bison lived, which was different from his ancestor with small horns and small body size. He had a thick coat of brownish-brown color. Focusing on body conformation and fur color this form was identical with the North American bison (Bison athabaskae). Its numbers were particularly high at the end of the Ice Age.

The horse is one of the largest (most numerous) ice age fauna of Yakutia. The Lena horse dwelt in the late Pleistocene and had a thick coat, which protected it from severe frosts. Like modern Yakut horse, this animal foraged using hooves to rake the snowpack. This animal was the favorite object of hunting by primitive people. According to our data, the modern Yakut horse evolved from prehistoric Lena horses.

Cave lion is considered the strongest and most successful predator of the Ice Age. Lion remains are found over almost the entire territory of northern Eurasia and North America. In general, this animal was similar to its closest relative - the modern African lion. But the cave lion is well adapted to the cold climate tundra, was larger, but weighed less than 300 kg and did not have a mane as luxuriant as his contemporary. This animal lived in small families and during the Stone Age was the main food competitor and predator.

Until now, there are conflicting opinions about the cause of the extinction of the main types of mammoths have long believed that the mammoths and the members of the mammoth faunal complex were destroyed by primitive hunters. This is physically impossible, because at the end of the late Pleistocene mammoth fauna reached their greatest prosperity and were present in numerous populations. People did hunt them, and besides, with very primitive tools of hunting, they could only to some extent contribute to the extinction. The author joins those researchers who believe that the main reason for the extinction of mammoths and other mammoth fauna is a dramatic global warming at the end of Neopleistocene - late Holocene. This climatic optimum was much warmer than the previous ones. Northern expanses of dry tundra-steppe began intensive thawing turned topsoil into swamps, and long-haired mammoths, musk oxen and other hoofed animals could not adapt to new environmental conditions and were doomed to extinction. The mammoths' adaptations to a cold climate with thick skin, long hair, thick undercoat and huge tusks played its negative role in their lives.

The current stage of development of Yakutia mammals is within the Holocene (last 10,000 years) under the climatic optimum. Some species have a wider range of tolerance, adapted to new environmental conditions and survived a critical milestone, reaching ultimately the foundation of modern fauna of northeast Asia i.e. moose, caribou, bighorn sheep, brown bear, wolf, fox and other carnivores and rodents. Radiocarbon determinations and other data indicate only about 20 species (a number of representatives of the mammoth fauna) survived into the Holocene. C. C. Flerov (1977), citing a number of recent findings, believes that last Bison (Bison priscus athabaskae) is a direct descendant of the pozdneneopleystotsene korotkorogogo bison (Bison priscus occidentalis) in Siberia which survived to only two thousand years ago. And, musk ox remains found on the Bykovsky peninsula in the delta of the Lena have been dated to 3200 ± 40 and 3180 ± 100 years (Kuznetsov et al, 2001). The author concluded in 1980 (Lazarev, 1980) that the Lena horse remained in the Holocene and hypothesized that perhaps it is the ancestor of the modern Yakut horse. These horses are perfectly adapted to the harsh climate of winter, cold temperatures with frosts, and like other wild animals grazing in winter their plant food is revealed under the snow by use of the hooves digging in the snow (tebenevka). Remains of horses were unearthed by the author in1978 on the shore of the lake near Moychoon Hromskoy. The remains were dated by radiocarbon analysis to 3210 ± 80 years. Many then believed that Lena horse became extinct along with the mammoth around 10,000 years ago and did not believe the dates for the Moychoonskoy horse. Then the data was compared to the bone remains of horses from the cultural layer from the Neolithic at Kullaty near Yakutsk having an age of 3 - 4 thousand

years and new radiocarbon dates of horse residues from Lyakhovsky Bol'shoy island 2200 ± 50 years and Bykovsky Peninsula 4610 ± 40 years (Kuznetsov et al, 2001) confirmed the existence of the Lena horses in the Holocene.

Recently, researchers became interested in the question: "Is it possible to resurrect mammoths and other extinct animals"? One reason voskrescheniya mammoth cloning is particularly serious as this question includes Japanese scientists that had the opportunity to accompany the author on several joint expeditions in northern Yakutia in search of well preserved cadaver remains of mammoths. Japanese scientists conducted a series of molecular genetic studies of experimental samples of mammoth skin and woolly rhinoceros from Yakutia, but so far no positive results. It matters that permafrost for thousands of years causes intense soft tissue dehydration and deformation, eventually the cells are destroyed. Even if it is sometimes possible to detect the DNA of the nucleus, and they are viable they are not suitable for cloning. Another way to resurrect mammoths is the artificial insemination of sperm from a mammoth into a female Indian elephant, and therefore birth a hybrid animal where artificial selection breeding will bring it to the mammoth. Unfortunately, the testes of fossil animals in the permafrost are also deformed and therefore subject to destruction. For now the possibility of resurrection of the mammoth exists only in theory.

CHAPTER 6 BURIAL TYPES AND TAPHONOMY OF MAMMOTHS AND MAMMOTH FAUNA

Present all over Yakutia permafrost has preserved to this day and corpses and skeletons of extinct mammoths, rhinoceroses, bison, horses and other animals of the mammoth fauna. Within permafrost a significant portion of all unique remains known in the world, exist in the territory of Yakutia.

Over the past four decades by direct supervision and personal participation the author excavated a number of exciting new graves of mammoths and other representatives of the mammoth fauna. Among them, first of all, is a whole mammoth foot with hair, the corpse of the wolverine, and about 10,000 mammoth bones in Berelekhskaya "cemetery" on the Berelekh River (1970), the skeleton of the Shandrinsky mammoth with preserved innards from the river Shandrin (1971), part of the corpse of Abyisky mammoth in the middle reaches of the river Indigirka (1991), the head of the Yukagir Mammoth (2002), the Oymyakon mammoth (2004); Tirehtyahskogo skeletons (1970), Allaykhovskiy (1973), Akanskogo (1986) and Hromskogo (1988), mammoths of the Yano-Kolmskoy lowlands and Churapchinsky (1990), mammoth in central Yakutia, the remnants of skin and other soft tissue of mammoths near the rivers Shandrin (1992), Sundrun (1993), Maksunuoha (1997), Colima (1999); Churapchinsky rhinoceros skeleton with preserved skin and hair on the rear foot in the village Curapca (1972), the remnants of dead horses in Selerikanskoy from the headwaters of the river Indigirka (1968), horses from the river Moychoonskoy Lapchi (1976), and the remnants of the Mylahchynskogo bison corpse from the lower reaches of the river Indigirka (1971).

Analysis of the radiocarbon dating shows that almost all of the burials occurred during a period from 10 to 50 thousand years ago. There are two relatively short phases of frequent death and burial of ancient animals.

The first stage occurred from 30 to 50 thousand years ago. This corresponds to the Karginsky mezhlednikovyo, which is known to have relative warming. This warming caused thermokarst development processes and enhanced river activities, waterlogging tundra, expanding the distribution of thermokarst lakes, damaging coastal areas of rivers, lakes and seas which led to death and burial of mammalian bodies. Shallow perennial frozen soils helped to preserve them until today.

The second stage of frequent burial occurs at the end of Sartan epoch glaciations from 9 to 14 thousand years ago at the start of the Holocene climatic optimum. It should be noted that during the Sartan glaciation conditions for mass death and burial of animals became smaller. Glaciation was caused by a cooling of the climate and an increase in humidity. Vast areas were occupied by tundra and thermokarst processes had limited development. Only at the end of Sartan time when the early Holocene climatic optimum started, again activated thermokarst processes and created a network of new natural

"traps" in koyuryh which killed and preserved the bodies of animals of the mammoth fauna. During this time the burials at the Berelekhskaya mammoth "cemetery", the Taimyr mammoth skeletons, the mamontovogorskogo rhino and other animals occurred.

The causes of death and burial conditions of mammals in permafrost has been studied enough that the reasons for the sudden death of these animals and the preservation of their corpses to the present day has been discussed in the works of N.K. Vereshchagin (1971,1977,1995), P.A. Lazarev (1975,1980) and other researchers of the northern territories.

Frequent death of mammoth and other representatives of the mammoth fauna in Yakutia, is primarily due to various natural factors. Among them are active varieties of water flows, seasonal permafrost processes, intense protayka soils, powerful floods and coastal erosion. And the types of burials of different animal species differed somewhat, due to the specifics of the development of space. Animals that lived in the river valleys are more likely to fall into numerous natural traps. The remains of these animals are dumped in sandy sediments, where the bones of the skeleton were predominantly yellow and light gray color. Well mineralized remains of the inhabitants of tundra-steppe peatlands usually were dumped in loess-like loams of oceanic thermokarst lakes and coastal bays. Under the long term impact of these deposits the bone and skeletons gain a dark brown and black color due to mineralization. In contrast bones that have been deposited for long periods in salt water have a characteristic bright brown color and are well mineralized.

Most natural traps that caught large heavy animals were those that easily fall through the thin ice, were stuck in coastal marshes or mud flows, or froze into the bottoms of wetlands. Apparently, this can explain why the most frequent finds of mammoth cadavers as most numerous residues as compared with the other mammoth fauna representatives. However, some mammals died as feeble old and young individuals, unable to overcome the natural barriers and natural situations.

We have classified the possible causes of death and burial types of mammals in the late Pleistocene below.

Floods and flooding. Animal mortality occurs on the rivers during floods on vesenneg and torrential downpours during the rainy season can be devastating. Considering the rivers of Yakutia the spring floods are very rapid and violent, the water level often rises a few meters before your eyes. This is due to the formation of ice jams in narrow parts of the river which forces ice drift to suddenly "accumulate" on shore. Then, water floods islands creating extensive flood plain space, taking all life in its path. Animals in such waters with powerful rubbing ice usually die from hypothermia. Dead animals wash ashore, exposed on the shoals in the lower reaches and in estuaries where silt, rock debris and coastal sediments bury them.

"Liquid" sands. Another type of burial on the rivers is connected with powerful channeling of sediment creating "liquid" sands and silts in the mouths of small rivers and streams. When large animals fall into such traps, they cannot move and find themselves buried.

Ice "traps". Many animals died in polynyas and on thin ice of rivers and lakes as they were leaving places for watering and crossing. Quite often large numbers of domestic animals die in this manner. This type of burial applies to the Berelekhskaya "cemetery" of mammoths on the banks of the Berelekh within the basin of the lower reaches of the river Indigirka. This unique burial of mammoths formed under highly specific conditions so the taphonomy deserves attention as there is a need to prevent animal mortality from ice traps.

So, concerning the origin of the kostsnosnogo horizon there are different interpretations according to Yakut archaeologists, referring to open sites in the vicinity of the Paleolithic "cemetery", which they thought consisted of the trophies of primitive hunters. In our view, it is unlikely such a mass of bones with heavy heads and legs of mammoths could be dragged over long distances from hunting spots. In this regard, a more plausible version from N.K. Vereshchagin (1977), in which the

various groups and large herds of mammoths, crossing the river on the ice still flanked by an immature individual, falls through the ice and dies. Then their corpses drift over to the nearest bend of the river and there they are buried in fluvial sediments. At the same time, I think, a decisive role of hunters is they may have forced the mammoth onto the ice. We have also noticed a feature in the behavior of animals on the ice, characteristic of modern ungulates, which is certainly peculiar and probably existed in Pleistocene animals i.e. when ice cracks the animals will fright-huddle in one group and the ice cannot withstand such loads. These particularly common situations probably killed mammoths. In one horizon bone depths equal to 2.5 - 3 m, indicate that the fossil remains of mammoths accumulated over the years. In some places outcrops are cut vertically and horizontally with ice veins of muddy color, arising as a result of filling frost cracks, which can often break even large tubular limb bones of mammoths. On the wall of one of the excavation site, for example, the exposed skull of a mammoth was chopped into two parts by an ice wedge vein. As a rule in the ice, fossil remains are absent. Judging by the arrangement of bones, frozen pressure causes very intense deformation, which affects the strong bones of mammoths e.g., a mammoth lower jaw with its ascending branch breaking through the massive ilium of a pelvis. The same phenomena is often observed in studies of the small bones of young and juvenile mammoth with which are found the remnants of fetal calves. Of particular interest are a whole mammoth hind leg (length 1.75 m with attached hair, the absolute age is dated to 13,000 years) and the remains of the corpse of a wolverine and ptarmigan.

Cavities in the permafrost. Such features often arise along the slopes of river valleys and in the coastal regions of thermokarst lakes and northern seas. Rain and melt water, blurring the vein ice, create deep cavities. Turf and moss cover remain intact and animals falling into such cavities freeze solid in position and thus find themselves buried for thousands of years. Similar traps have killed animals today.

Baydzherahi. The baydzherahovye landforms often caused the death of ancient animals. Baydzherahi, sometimes occupying large areas of several kilometers, are developed in the coastal zone of rivers, lakes and seas when water erosion hollows out polygons in the tundra. At the edges of the polygons powerful vein ice is exposed and in the middle of them remains conical earthen outliers. Ground collapses with the upper layers of the outcrop sliding down on the surface of the ice core, creating mudslides which are traps for large animals. These traps can cover an entire area under bechevnikovuyu water. In all likelihood, this type of trap at the end of Karginsky interglacial trapped eighteen bison and two mammoth on the bank in the Indigirka in the localities of Mylahchynsky and Abyisky respectively.

Kuta. Coastal bog Yakut called "Kuta" the formation of a thick moss layer arising from the shores of thermokarst lakes which over time cover the surface. “Kuta” are usually covered by dense reeds so these become a quagmire and are hard to notice. Animals fall into them and die. There are very many cases in recent times where our livestock and horses are victims to the "Kuta". This trap type was responsible for the remains of the Allaykhovskiy mammoth (1973). This is evidenced by the presence of lake sediments with inclusions in a layer of peat enclosing the remains of the animal.

Loess. Some researchers believe these are eolian, others - lacustrine-alluvial in origin. This issue still remains controversial. Burial in these deposits usually occurred after the decomposition of corpses and maceration of the skeletal bones. This is confirmed by the results of our studies of nibble traces and bone health. To this type of burial, for example, include the woolly rhinoceros skeleton ostagki in surface level late Pleistocene loess-like loams, excavated by us in 1976 in the hollow outcrop of Mammoth Mountain in the lower reaches of the river Aldan. Bones of the skeleton, skull with horns, the lower jaw, some vertebrae and limb bones were found in a layer of loess-like loams lying close to each other, but the skeleton anatomical order was violated. The upper ends of the humerus up to the mid-diaphysis were bitten by predators likely due to wolves.

Primitive hunters. The role of Paleolithic humans in the formation of burial remains of mammoths, compared with the above described natural traps is small. Nevertheless, anthropogenic types of burials took place. This is evidenced primarily in the cultural layers of Paleolithic encampments containing numerous fossil remains of animals as trophies of primitive

hunters. The formation of cultural layers was a perennial phenomenon. Multilayer burials arise when man frequented an area intermittently. On the other hand, human driven hunting probably contributed to the burial type of the Berelekhskaya mammoth "cemetery".

Jute. Mass mortality of animals has been caused by jute. Jute results from the formation of ice layers (crust) on the surface or in the depths snezhpogo of snow cover, which hinders access to plant food under the snow. Animals suffered especially small animals when moving through the snow, the path is "punctured", thus becoming easy prey for predators.

Mor. Parasitism by insects as the cause of death of animals. Today, for example, an attack of midges may kill hundreds and thousands of wild and domesticated reindeer.

Disease. Animals also died of various diseases associated with the use of coarse fodder food, nasopharyngeal lesions by subcutaneous gadfly and all sorts of injuries and diseases from helminths. In this regard, curious, although considered insufficiently yet substantiated by the findings of Yu.F. Yudichev and A.I. Averikhina (1982 the Shandrinsky mammoth possibly died of asphyxiation, which occurred due to acute flatulence in the gastrointestinal tract from eating heavy, rough meals. Data on the distribution of anthrax among the mammoths is not available. During our excavation of various mammoths and other faunal remnants under examination the practice of testing for anthrax has not been standardized. However, animals were observed with lifetimes of chronic bone diseases and injuries. For example, some bones had deep holes which are the traces osteomyeloma disease and multiple growths. Animals are often traumatized. For example, the famous mammoth Berezovsky fell off a cliff, breaking its hip, which was the immediate cause of his death. Also, broken off during the life of the animal are antlers of deer, elk, and mammoth tusks, apparently, as a testament to the struggles between fighting males.

There were times when kormoobilnye pastures due to intensive melting permafrost turned to mud or became overgrown with coniferous forests, where the main increase in plant biomass was in nutrient poor components such as wood and needles.

In conclusion, it should be noted that the important condition for the preservation of the remains of Pleistocene mammal cadavers in the permafrost is immediately after death on the frozen substrate, the corpse should undergo rapid freezing. However, in the practice of burial site excavations within instances of frozen ground the perfect preservation of soft tissues are not yet known.

CHAPTER 7 STUDY OF THE REMAINS OF CORPSES AND SKELETONS OF MAMMOTH AND OTHER MAMMOTH FAUNA (1968 - 2004)

Given the exceptional scientific value of cadaver remnants and skeletal remains of mammoths and other creatures of the Ice Age, the results of research in this chapter are covered in more detail. Excavation and research was conducted under the direct supervision of the author, who for the past 40 years has been an organizer and participant of paleontological expeditions in Yakutia. Excavations of unique burials of mammoths and other representatives of the mammoth fauna in Yakutia have been conducted using special instructions developed by the author (see Chapter I).

Fossils of extinct animals with preserved soft tissues, organs and some remnants of viscera give us the opportunity to reconstruct their appearance and anatomy of internal organs, and identify ecological, physiological and morphological adaptation mechanisms, including the role of nature. Below are the summaries of results of geological, geomorphological, taphonomic, palynology, paleobotanic, radiocarbon, paleontological, anatomical, morphological, exterior, histological, cytological, microbiological, molecular genetic and other types of research. Occurrences described are burial locations of mammoth and mammoth fauna.

7.1 THE REMAINS OF PREDATORS

The Berelekhskaya wolverine. This incomplete specimen was discovered in 1970 in the bone bearing horizon during excavations of the Berelekhskaya mammoth "cemetery".

The corpse lay at a depth of 5 - 6 m with bone remains. At the top of an outcrop the wolverine head lay on its back. This specimen was of larger size than the remains of a skull and other bones found in more zapadpyh regions of Russia. The preservation of soft tissues is about the same as that of the hind leg of a mammoth unearthed by us there. Microbiological tests for anthrax research were conducted at Korneev, but did not yield positive results. Judging by the degree of wear of the teeth and the size of the corpse, the wolverine was an adult male. Radiocarbon dating established the age of the Berelekhskaya "treasure-bischa" mammoths at about 10 - 12,000 years ago. The remains of the corpse of the Berelekhskaya wolverine are kept in the Zoological Museum of Sciences in St. Petersburg.

7.2 THE REMAINS OF MAMMOTH

The Berelekhskaya mammoth. The complete rear right leg of this small mammoth raskopapa was recovered in 1970 at the Berelekhskaya "cemetery", 1.5 m below the corpse of the above wolverine (Vereshchagin, 1971, 1977, Lazarev, 2002). Around the leg were many straggling hair bundles. Under a scanning electron microscope you could see the rough surface of the hair with an irregular rounded shape in cross-section. Leg length (restored by N.M. Gubanov and the author) was 175 cm. The upper part of the leg above the knee was covered in long hair and below the knee the hair was shorter and tighter. In the knee area was a visible hairless surface (the size of 15 x15 cm) which was formed, apparently as a result of friction with the ground. The leg belonged to an adult, but medium-sized specimen. The Berelekhskaya mammoth population is characterized by more recent time measures. Absolute age of the leg was 13,000 years.

The Tirehtyahsky mammoth. This mammoth skeleton with preserved soft tissue fragments was excavated in 1971 in the lower reaches of the Tiryahtyah area on the right bank of the Indigirka. From this mammoth a large piece of skull with preserved skin folded into pleats was recovered. The skin thickness was thin, 4 - 5 mm. A well preserved small fragment of the foot of the front leg including the skin and soles was also found. The foot fragment was strongly mummified and was gray in color. The left tusk is very well preserved, pale yellow with a brown tint along about 3 meters of its length. On the surface of the tusk are visible thin transverse bands. According to some studies investigators suggest the bands are formed each year by physiological activity of the animal. This mammoth died in the late Pleistocene during the Karginsky interglacial era. The absolute age of this mammoth was 32,200 years.

The Shandrinsky mammoth skeleton is a very good anatomical assemblage found in 1971 by D.D. Kuzmin on the right bank of the Shandrin, a tributary of the Kolyma River in the Indigirka delta. This was the first time in history that the ribs in a mammoth find served as a protective cage. Inside we found a significant piece of internal organs, which were preserved in the form of a frozen monolith weighing about 300 kg. In addition, under the influence of weathering on the surface of all the decomposed viscera we observed many pupae of gadfly, which were later identified by Y.A.K Grunin as a new type of gadfly pupae.

In the winter of 1974 the Shandrinsky mammoth skeleton along with the innards and cadaverous remains of the Mylahchynskogo bison were transported to the Biological Institute of the USSR Novosibirsk, afterward a comprehensive study in fifteen cities of the USSR was conducted by renowned paleontologists, pathological anatomists, palynologists and other specialists. During the study researchers hypothesized that the animal's death was caused by an accidental cause: asphyxia due to acute flatulence in the gastrointestinal tract as a result of eating large amounts of indigestible grass, sod and twig foods (Yudichev, Averikhin, 1982). The internal organs revealed a badly damaged thin diaphragm wall, a thin

walled stomach with shredded plant food of herbs, intestines, liver, kidneys, pancreas, abdominal mygatsy with bloody footprints, and large blood vessels.

V.G. Provotorova and A.Y. Ryabikov (1982), conducted biochemical studies of the stomach contents and intestines and found that the main biochemical parameters of the Shandrinsky mammoth are similar to those of modern ruminants. Histological study of residual muscle by R.P. Geneva (1977) identified the boundaries of muscle fibers, muscle proteins and transverse striations. There was a marked decrease in muscle size several times due to intense deformation and withering influence from the surrounding frozen soil. On the macro-content of the gastrointestinal tract R.N. Gorlov (1982) found that 80% of the plant mass were epithelial tissues and fibrovascular bundles of grass, 15% of fragmented pieces of chewed wood, twigs and bark, 1% in leaves, twigs and hypnum sphagnum moss, and 1% in heather shrub leaves. Analysis revealed 20 species of plants belonging to the boreal and hypoarctic forms. The Shandrinsky mammoth died during the Karginsky mezhpednikovya late Pleistocene. The absolute age was 41,170 years.

The Allaykhovskiy mammoth is an almost complete skeleton of a large mammoth found in 1973 by D.D. Kuzmin, who is the pioneer researcher of the Shandrinsky mammoth. The burial of this mammoth occurred in loess loam at a depth of 5 - 6 m in a steep cliff 20 meters from the surface. This mammoth, according to its stratigraphic position of enclosing layers, died at the end of Karginsky interglacial.

The Kieng -Yuryakhskoye mammoth carcass was found in 1985 when miners of the Kular mine were open blasting in the lower reaches of the Kieng -Yuriakh valley. The burial site lies at a depth of 1.5 m from the surface. After the explosion a large piece of skin from the left side was found: size 200 x 100 cm, a brown much mummified leather, its surface uneven with wrinkles, pits and tubercles. Partly visible was hard red hair of a length up to 15 - 20 cm on the inner side of the skin fragments of the ribs. Also recovered were the lower the end of the humerus, radius and ulna, and on these bones were fragments of tendon and muscle tissue. This mammoth supposedly died in Karginsky interglacial era of the late Pleistocene about 30,000 years ago.

The Abyisky mammoth was found in September 1990 in the area of Mylahchyn located on the right bank of the Indigirka 45 km from the village of White Mountain. The locals found its cadaveric remains during excavation of frozen soil and removed the head, lower jaw, two dairy tusks, trunk, ear, tooth chip, 29 ribs, vertebrae fragments, front left leg with skin and hair, two horny hoofed feet, right forearm skin as well as a large piece of wool. We believe this mammoth died at the age of two months in a mud flow. At the bottom the head, the feet and trunk were apparently frozen in ice, which preserved the soft tissue, skin and coat. Part of the carcass, that remaining outside and partially decomposed was taken by predators. Judging by the complex of spore-pollen plant residues contained in the enclosing sediments the corpse lived probably in the transitional period between Karginsky warming era and the last glaciation (Sartan) in the late Pleistocene. And, since the mammoth was buried in the same layer at the Mylahchyn location as the corpse and remains of the bison (1971), we can assume an age of about 30,000 years ago.

In the summer of 1993 on an island in the south estuary of Bol’shoy Lyakhovsky a geologist A.A. Archangelov found the Eterikanskie mammoth. Archangelov discovered fragments of the front legs and not far from it, a large piece of skin from a front foreleg, a fragment of a young mammoth complete with skin and pale and yellow hair with a length of 35 - 40 cm. At the front of the foot were three horny hooves. The foot diameter was 30 cm. The foot sole was strongly mummified.

The mammoth from the left side had fairly large dimensions: length 219 cm, width 92 cm and in front-top of the head, well preserved skin with eye socket and ear. The ear has an unusual rounded shape valikoobraznuyu with a length of 30 cm, which apparently is the result of permafrost deformation. The area above the ear and scalp remained dark red in color. The absolute age of the foot was 26,860 years (Saydze et al 1995). In 1994 a fragment of the front legs and skin of

the Eterikanskogo mammoth from Bol'shoy Lyakhovsky Island were taken to the Mammoth Museum, Academy of Sciences, Sakha, (Yakutia) Yakutsk.

In the autumn of 1995 during a joint expedition with naschimi colleagues from Japan, the Zoological Institute and MSU south of the same estuary of the Eterikan river shoreline was found a small piece of skin from the back of the left leg with a well preserved mammoth anus. The skin size is 200 x 140 cm with dark brown hair and was not present with the body suggesting ochislennymi destruction. Also found was a tibia of small size (50 cm) suggesting that the skin belonged to a mammoth of 3 - 4 years of age. The above remains of Eterikanskie mammoths dated within 25,000 - 36,000 years, indicating they were buried during the Karginsky interglacial. Since the graves of the mammoths were within a relatively small area this suggests the presence of a natural type mud flow trap.

The Maksunuohsky mammoth. The burial of this adult mammoth was discovered in 1994 on the right bank of the river Maksunuoha near the Laptev Sea. In 1997 the foot of the front leg was retrieved. In 2002 during final work, frozen soils were removed which had been pressed together with the other front leg and back foot of the mammoth, frozen in the form of a monolith. According to our data, the mammoth was of medium size with a height at the withers of 270 cm.

As a result, histological, microbiological and virological studies of samples of soft tissue from the leg of the Maksunuohskogo mammoth were conducted. V.E. Repin with the author and other researchers (2003) found well preserved structures of muscle tissue, hair follicles, sebaceous and sweat glands, blood vessels, skin, and whole arteries. In the deeper layers of skin were found fairly well preserved cells, and studies by scientists have concluded that unusual ecological conditions lead to the formation of some unusual microbial communities. This mammoth was buried in the loess-like loams, the so-called, Edomnoy formation in the late Pleistocene Karginsky interglacial.

The Yukagir Mammoth burial was found in August 2002 on the shores of an ancient lake on the right bank of the Ilene-Byrahchaanna (left tributary Maksunuoha) which is 30 km northeast of the village of Yukagir.

Yukagir mammoth remains consist of the head with the skin and two tusks, the front legs with the skin and bones of skeleton from the front of the carcass, and are of great scientific value. Of its head were well preserved eye sockets, the left ear and the remnants of coarse hair of auburn colors.

Judging by the tusks, the mammoth head belongs to an adult at the age of about 40 years and this mammoth died according to radiocarbon dating (University of Groningen, The Netherlands) 18,000 years ago, i.e. in early Sartan glaciation late Pleistocene. Currently underway are molecular genetic, histological, cytological and microbiological studies of soft tissues. Samples of the contents of the gastrointestinal tract are being studied by botanists and palynologists.

In the history of research findings the well preserved Yukagir mammoth is of very rare scientific value and can be put on a par with the Adams mammoth (1799), the Berezovsky mammoth (1900) and the Magadan mammoth (1977).

The Oimyakon mammoth discovery is the fifth in the world and second in Yakutia of a young mammoth. These remains were found in August 2004 in mining debris on the right bank of the Olchan (a tributary of the Indigirka) and 80 km from the village of Ust-Nera. Recovered was the front part of the body from a year old baby mammoth kozhnm including the head with preserved eye sockets, ears, trunk fragment, and parts of the chest and back. According to preliminary data of geological and taphonomic conditions of the burial, this mammoth died about 15 - 20 thousand years ago in the early Sartan glaciation late Pleistocene. In the ruins of frozen host rocks we found pieces of dark red hair and icy sediments with reddish color. Perhaps this mammoth drowned. Causes of death are unknown. The length of the preserved part of its body from the base of the trunk to the rear edge of the back is 112 cm. Diameter of the trunk below the top is 78 cm and ear

length is 15 cm. Length of the orbit is 6 cm. Length from the posterior edge of the orbit to the lower end of the ear is 19.5 cm and 29 cm for the width of the forehead. In the future comprehensive studies of this mammoth will be conducted.

7.3 THE REMAINS OF WOOLLY RHINOCEROS

Churapchinsky rhinoceros is one of the great paleontological discoveries of the last decades, the third in the world of importance of this kind of discovery was found in 1972 in the center of the village Curapca 140 km east of Yakutsk (Lazarev, 1977, 1998). As a result of our excavation of frozen ground at a depth of 2.5 - 3.6 m we recovered an almost complete skeleton of a woolly rhinoceros with skin and right rear leg with soft tissues, lacking only a portion of the right forelimb to the wrist, the left hind limb below the hips and tail vertebrae. A scattering of animal bones were also about having a square shape distribution. The thickness of the skin of the foot is 3 - 4 mm and from the host rock using a sieve we retrieved a lot of wool hair. In the form of dense clumps of chewed grass the contents of the gastrointestinal tract is of great interest to science (Figure 5). The diameter of the one clump was 10 x 15 cm, which possibly could have formed a stool. Judging by the location and nature of the burial, it can be assumed that the animal drowned in the swamp just before a frost.

The Churapchinsky rhino remains were buried in brown loess-like loams in a thermokarst depression 100 m from a lake. In the study of residual contents of the gastrointestinal tract of the animal, the spore-pollen analysis (Lazarev, Tirskaya 1975) showed results clearly characteristic of steppe-like herbaceous vegetation the composition of which is dominated by grasses (89%), wormwood (8.2%), and less represented sedge and Chenopodiaceae. About the same spore-pollen spectrum with a predominance of grasses and sagebrush from meadow and steppe vegetation is described by V.E. Garrutt and others (1982) who also examined the preserved remains of food from the teeth of the woolly rhinoceros.Thus, it was found that the Churapchinsky woolly rhinoceros habitat in central Yakutia consisted of developed meadow-steppe areas interspersed with small forests of larch, birch and some hypnum.

Mamontovogorsky rhinoceros. Part of the skeleton of a woolly rhinoceros was found in 1976 by schoolchildren from Ust-Tutte in the upper epithelial layers of loess loam, 80 meter terrace location at Mammoth Mountain on the left bank of the Aldan. The burial is in the upper part of a small gully in a large landslide spolzshey downhill 15 - 20 m. The reason for the formation of the landslide was intense defrosting of ice wedges.The structure of deposits in the landslide have been preserved in their original form. Burial parts of the skeleton were found on the site (2 x 2 m) at a depth of 1 - 1.5 m from the surface to the bedrock. The preserved skull, lower jaw with a full row of teeth, two horns, forearm, left shoulder, and ribs were retrieved (Figure 6). The anatomical sequence of skeleton was broken. Judging by age nezarosshim seams on the skull and limb bones epiphysis, the skeleton belongs to a young individual. Separate remains dropped out of the primary burial and were scattered down the slope to the bottom of the gully. The skeleton was missing about 25% of the bones of the forearm, also the front legs, hind limb bones, several vertebrae and ribs. In the mounted skeleton the missing bones were supplemented with those from other rhinos (Figure 7).

The length of the rhinoceros skeleton from the mouth of the skull to the rear point of the buttocks is 270 cm. The maximum width between the outer edges of the skeleton ribs is 69 cm, height to the top of the most prominent acute process of the thoracic vertebrae 149 cm, skull parietal length 72.8 cm, zygomatic width 32 cm, length of the tooth row 21.2 cm, the maximum length of the mandible 4.5 cm, and mandibular incisal width 9.8 cm. The skull with a short parietal bone is characteristic of a late milking rhino. A relatively short and little curved front horn suggest this particular specimen is of young age. The horn length on the greater curvature is 68.1 cm and the lesser curvature is 54 cm. The horn is strongly flattened and its greatest anterior-posterior perpendicular diameter is 24 cm narrowing to 5.8 cm. The front horn gradually thickens. The posterior small horn tapers conically to the top. The tip of this horn is slightly curved back. From the base the rear horn angles forward, its length on the greater curvature is 22.9 cm and on the lesser curvature is 17.4 cm. The Mamontovogorsky rhino, judging by the stratigraphic status of the host rocks and a small degree of mineralization, died in

late Sartan glaciation at the end of the late Pleistocene. The skeleton is on display in the Museum of Mammoth IPES Academy of Sakha (Yakutia) in Yakutsk.

It is appropriate for us to describe the woolly rhinoceros skin fragment we found in 1999 at the Duvanniy yar location downstream on the right bank of the Kolyma. The piece of skin with a size of 80 x 90 cm was found in sandy dark gray bedrock with powerful vein ice, at a depth of 7.2 m in the context of the 15 m outcrop (Figure 7). The skin thickness is about 2 cm, yellowish-gray color, crumpled into folds and apparently is from the back part of the lateral surface of the animal. Skin samples from this individual were examined by experts from Kinki University, who participated in the work of our expedition. The absolute age of this rhinoceros is 27,470 years (at the end of the Karginsky interglacial). The exhibit is kept at the Museum of Mammoth IPES Academy of Sakha (Yakutia).

7.4 THE REMAINS OF HORSES

The Selerikanskaya horse. In January 1968 the miners at the top horizontal shgreka at depth 8 - 9 m, embedded in the stream valley of the Selerikan river basin near the upper reaches of the river Indigirka found the remains of the Lena horse corpse. In March of the same year using explosives a local team extracted from the frozen soil in the form of a frozen monolith the horse carcass with the remnants of host rocks weighing 120 kg at a depth of 7 - 9 m. The Selerikanskaya horse was buried there with underlain loess, loam and sand with different inclusions (Galyshev size 2 - 3 cm). With rarity in mind and exceptional scientific value what follows here is a more detailed description of the selerikanskoy horse. Spore-pollen in the lower strata of the assemblage where the horse carcass was buried was dominated by pollen ostepnennym types of shrub and herbaceous plants (73%) and prevailing grass, sagebrush, sedge and clove. The upper stratum sectional sediments to a depth of 6 m were represented primarily by forest type of pollen. Thus, Selerikanskaya horse lived in conditions of steppe landscape with limited development of forests. This identified spore-pollen complex is typical for the Karginsky era of the late Pleistocene interglacial.

In the burial Yulova had not detected, that the front part of the body was lifted, the front left leg was vygyanuta forward and the hind legs were slightly bent (Figures 8, 9). The situation of the remains suggested that the horse collapsed in a sandy loam oily liquid niche. The horse carcass in frozen soils was significantly deformed, but the internal organs had no trace of the same problem. Based on the condition of the skin, we believe, the carcass has undergone partial decomposition of the skeleton, except the skull which was preserved almost entirely.

In January 1969 the corpse of the selerikanskoy horse was accompanied by the author and taken to the Leningrad Zoological Institute of the USSR. Thawing and preparation was done by M.A. Zaslavskim, G.F. Baryshnikov, the author and other experts led by N.K. Vereshchagin. Samples were taken for comprehensive research. Our results confirmed that the Selerikanskaya horse is a representative of the Lena horse. The carcass of the horse is a chestnut stallion of adult age. The length of individual hair on the sides of the legs reached 50 - 60 cm. Wide hooves with strongly worn front edges indicate adaptation of the horse to the soft, apparently swampy ground and for use digging into snow cover. Withers height and leg length are equal to 134 - 136 cm, and these dimensions suggest a group of undersized horses with average degree of massiveness.

The horse exterior. Because the horse carcass was locked in frozen soils it was subjected to considerable strain, consequently size and proportions of the body were calculated from coefficients [L. Kizevalgera (1889) and V.O. Vitt (1952)]. The approximate height of the horse is 134 - 136 cm, body length 140 - 142 cm, chest depth 65 - 70 cm, and height is 80 - 82 cm at the elbow. According to these parameters the Selerikanskaya horse refers to an undersized specimen yet it is the closest relative to the modern Yakut horse, but slightly larger than the Przewalski horse.

When comparing features and exterior bone characteritiscs of the Selerikanskoy horse stallion with the present Yakut horse, especially from the north of Yakutia, there is a striking similarity of all their main parameters. This allows us to hypothesize that the modern Yakut horse originates from Lena horse. These findings also agree with data from the remains of horses of Holocene times (I. E. Kuzmin et al, 2001). However, for final approval of this hypothesis additional materials and study is required.

The skin of the Selerikanskoy horse is best preserved on the legs, tail, and in the chest and rump. The skin had a brownish-gray color, but sometimes has a yellow tinge. According V.E. Sokolov (1977) who studied samples of skin, the epidermis is not preserved but the reticular dermis is much better preserved where bundles of collagen fibers are present in collagen. Fat cells are not detected and there are no sweat glands or muscles. The sebaceous glands are preserved in the form of compact bodies. The thickness of the skin on the hind leg was 2.1 - 2.3 mm and 3 mm on the rump. Muscular tissues were severely dehydrated and became very brittle. Fat layers from the skin turned into a shapeless yellowish mass, so we decided to save bunches of tendons.

The Selerikansky bay stallion scalp was well preserved with hair on the legs, tail, and sometimes on the chest, neck and rump (Figure 11). Hair length at the shoulder area reached 80 - 90 mm on the rump and 50 - 60 mm on the legs. Stiff black hair with a length of 120 - 150 mm was also present (N.K. Vereshchagin, P.A. Lazarev 1977). This long and thick hair is the result of adaptation to the cold climate. A lush hair coat is also present in modern Yakut horses. This hair coat is beneficial when even in winter all grazing is out in the open. The Selerikanskaya horse may have had a mane about 15 cm long but, based on scraps of hair it is difficult to judge the length of the long hair on the neck and tail. Hair length measurement results ranged from 20 - 60 mm and it is possible that a significant portion of the hair was removed when the frozen ground was disrupted by the explosion (Figure 12). The Selerikanskaya horse had a darker color than the Przewalski horse.

V.E. Sokolov (1977), who studied Selerikansoy horse hair under a scanning electron microscope, found that in cross section, the hairs are oval and bean-shaped. The sebaceous glands are preserved in the form of compact bodies. Hair at the base is thickened and narrowed gradually toward the middle. The hair cuticle is of nekoltsevidnoy form. The cuticular borders of the hair follicles have fewer cells and are smoother than those of the domestic horse. And, the cuticular cells are higher and less elongated being rod shaped in diameter compared to the modern horse.

All horny hooves of the horse were in good condition (Figure 13). At the left front leg the hoof was chipped on the outer bottom edge. The hoof on the right foot had visible mechanical crosscuts. The upper edge of the front surface was strongly erased caused as a consequence of frequent abrasions during winter. On the front of the hooves of the front legs there are several transverse grooves. The hind hooves are less pronounced than the front hooves. The height of the front wall of the front hooves is 80 mm, rear wall 92 mm, and their width, respectively, 123 mm and 120 mm, the total reference area - 115 cm2. The bearing surface of the hooves in modern Yakut horses is a little larger than that of Selerikanskoy horse as it lives on a soft, damp soil the horny hooves are relatively long and narrow.

As a result of deformation in permafrost conditions the internal organs mnogoleshey have a distorted shape and dimensions (N.K. Vereshchagin, P.A. Lazarev 1977). The heart size is 18 x 12 cm and preserved fragments of blood vessels of the heart wall have a thickness of 10 - 12 mm. The lungs show snippets of the trachea and bronchus. The mummified lung thickness is 10 mm and has a bugriouyu surface resembling elastic foam rubber. The liver has a strongly flattened shape with a size of 24 x 33 cm, yulschina thickness of about 25 mm and the edges are thin and taut. The spleen size is 8 x 12 cm with a thickness of about 12 mm and light brown in color. The liver tissue is elastic. The stomach and intestines contained a significant part of the gastrointestinal tract. Due to permafrost the wall of the stomach and bowel conditions were strongly dehydrated and became very fragile. The stomach remains were filled with chewed plant material, brown in color. According to researchers N.G. Solonevich and V.V. Vikhireva (1977), 90% of the contents of the

gastrointestinal tract consisted of cornflower herbaceous plants. Wood residues were 5 - 7% and residues of mosses were 1 - 2%. The herbs were dominated by cereals. Sedge and grass occupy a small portion of the seed carpology. By analyzing the contents of the gastrointestinal tract T.V. Egorova (1977) found that the fruit kobresia as part of the vegetation in habitats of the Selerikanskoy horse was missing. Apparently, this kind of plant disappeared during the colder climate during the Sartan Ice Age. Based on the mature seeds of grass vegetation present the horse died in late summer. The composition of tree species was represented by the young shoots of birch and willow.

For microorganisms bacteriological samples were taken from leather, wool from the hip, chest tissue, muscle tissue and content of the deep layers of the colon. As a result of thorough research anthrax was not found (R.A. Zion, 1977) in the subcutaneous tissue and skin but spore colonies were found on the surface. The microflora of infectious agents and sporoobrazuyuschihsaprofitov not mentioned revealed colonies of fungi identical to modern species. R.A. Zion admits the possibility of introducing them to the carcass of the horse during preparation.

After preparation of the Selerikanskoy horse carcass we evaluated the significant parts of its skeleton. As mentioned above, the horse's head in the place of burial was not detected. Description of the bones was performed by the author together with N.K. Vereshchagin (1977), followed by a comparative analysis of them with Przewalski horse, Equus caballus latipes and modern Yakut horses at the Zoological Institute. The skeleton from the Selerikanskoy horse is registered under number 30956 and the bones and skeletons of the modern Yakut horse and the Przewalski horse used for comparison, are in the collection of the Zoological Institute.

Thus, as can be seen from the brief review, the size and morphological structure of each skeleton of Selerikanskoy horse and late Pleistocene horses from Yakutia are almost identical. Data suggests that the corpse from Selerikane is a typical Lena horse. In this regard, we are interested in the characteristics of skulls known from other localities. Great similarity was also observed in skeletons of the pozdneneopleystotsene Selerikanskoy and modern Yakut horses. The question of whether there is similarity phenotypically or a consequence because of their genetic relatedness, this paper does not discuss in detail.

There are multiple versions of the horses that lived in Yakutia lands in prehistoric times. Przewalski's horse compared to the Lena horse is massive with large bullheaded skull, shoulder of longer beam, short metacarpals, elongated second and third phalanges, and short metatarsal bone. Nevertheless, some researchers accept the assumption that Lena could be a transformed Przewalski horse.

In favor of the hypothesis that the Przewalski horse lineage diverged into the Lena area horse, according to N.K. Vereshchagin (1977), he stated metatarsal bone number 4326 (1) (in the collection of the Zoological Institute) from the river Yana looks similar to the remaining sixteen in the same series. This metarsal has the same size but the index differs sharply. Yet it is quite similar to the metatarsals of Przewalski horses. With this instance is a consistent metacarpal bone (№ 17146 (1) (in the collection of the Zoological Institute) from "Yenisei lips". At a Pleistocene age burial in Alaska's Yukon Valley C.R. Harington and F.V. Clulow (Harington, Clulow, 1973) collected a series of significant tubular bones of horses mainly from pozdneneopleystotsene layers. The remains from this series the authors refer to as an independent horse, Equus lambei, which was described in 1917. On the skull of one old horse glanders is evidenced and other bones of the skeleton of the Lambeya horse are in the museums in the cities of Whitehorse and Dawson (Western Canada) and as mentioned above, are smaller than the Gakova Lena horse.

Of particular interest is a left metatarsal bone (Mt III sin № 30977 in the collection of the Zoological Institute) from bystroalljurnyh Equus horse sp exceeding index dimensions of even Przewalski horse and approaching those of Kulans. This specimen was discovered by N.K. Vereshchagin at the regional museum in Yakutsk in 1956 among the mass of bones of mammoths, bison, and rhinoceros. Preservation does not differ from the Lena horse bones collected from soils of

Yana river valleys mnogolstnemerzlyh, the New Siberian Islands and the Indigirka. Perhaps this bone belongs to a young individual.

The similarity of the skeletons of the Selerikanskoy horse and the Yakut horse may be explained by convergence and direct genetic relatedness. The hypothesis of the existence of the wild Yakut horse still living in remote places has been raised repeatedly by paleontologists and livestock specialists (Afanasyev, 1953; Gabyshev, 1957; Rogalevich, 1938). M.I. Rogalevich (1938), in particular, quoted O. Antonius (Antonius, 1938), which is a reference to reports by Pfizenmayer suggesting that a white tundra horse allegedly existed in the area between the Kolyma and the Omolon Anyuem.

In 1900 according to Lamuts living in the area, wild horses (along with deer) were a favorite subject of hunting, similar in size to the Yakut horse with a long gray-white hair, their flesh having a different excellent taste. Rogalevich himself, however, thought it more likely that the white horses were feral horses from the Yakuts, but did not deny the possibility of interbreeding Yakut horses with local Pleistocene relict individuals.

It is interesting to note in this regard that in Neolithic Eskimo dwellings at Cape Baranov bones of a horse were found with the same type of preservation included with the bulk of bone remains of animals that lived during the later Middle Ages in the area of the settlement (Vereshchagin,1971). Then the mention of the Yakut horse was not known. It is possible that a wild ass or an equine very close to it existed during the late Pleistocene interval in a single Holarctic area of North America that will reveal findings similar to those of the Yakut.

Of course, questions of the survival of the Lena horse into the postglacial era and its possible domestication, as well as partial cross breeding with horses of later pastoral tribes have been offered by noted paleontologists and ethnographers. S.N. Bogolyubsky (1940) believes that the Przewalski horse is intermediate between donkeys and horses of southern and northern types. It is also obvious that clarity on the origin of the Yakut horse can only be achieved if the paleontologists, archaeologists, ethnographers together with livestock specialists obedinyats join together to solve this problem.

The osteological differences of the Lena horses shirokopaloy inhabiting the Russian plain in Eastern Europe is rooted in the Wurmian Paleolithic era. These differences are expressed by greater length of the metacarpal, talus and calcaneus, metatarsal bones, especially in hypertrophied long and massive I and II phalanxes in this shirokopaloy horse.

The Selerikanskaya horse lived in Karginsky interglacial epoch. Radiocarbon dating of muscular tissues showed an age of 35,000 years (LU-7) and on food of plant residues 38,590 ± 1120 years (DR-506). Remains of Selerikanskoy horses are kept in the Zoological Institute of Russian Academy of Sciences in St. Petersburg.

The Moychoonskaya horse. The remains of this horse were found poluiskopaemoy by E.V. Eduki in 1977 on the shore of the lake Moychoon near headwaters of the Lapchi. The burial was located at a depth of 0.8 - 1.1 m from the surface in the loess-like loams, highly saturated with dark brown peat. Parts of the skeleton of the horse were visible on the surface of vytayavshih frozen soil and were scattered and unearthed by foxes. During the excavation of the permafrost we recovered the skull, mandible, arm and forearm bones, the femur and the small bones and well-preserved hoof and wool remnants. The skull is brown-black in color, which is the result of staining by diffusion from peat deposits. Hooves were dark gray. The hoof sizes were wide and of large size as the result of morphological adaptation to the soft ground of a wetland landscape. The dimensions of bones and teeth structure are similar to those of the modern Yakut horse. According to radiocarbon dating the age of the Moychoonskoy horse is 2310 ± 80 (LU-1084). On the basis of this finding, the author (1980) first hypothesized that this Lena horse lived along with mammoths and was preserved throughout the Holocene. This conclusion of the author as indicated was supported podtverzhdatsya by radiocarbon dating of new discoveries of horse residues from the Holocene (Kuznetsov et al 2001).

The cadaverous mummified remains of the Dyukarskaya horses were discovered in 1981 by local residents. Dyukarskoe is located on the left bank of the lower reaches of the river Indigirka. The remains fell with a powerful vein ice during intense summer of loess loam defrosting. A fully preserved head to the waist and upper torso bent at 180 ° was found in the region of the left bank (Figure 15) at the waters edge. Leather from the horse is very thin and fragile. Partial decomposition and mummification of the carcasses apparently occurred before final disposal in unconsolidated sediments, so the preserved coat of the neck and torso is brown and the surface of the head bare. Upper and lower lips were turned up and down so as to bare the incisor teeth. The eyes were closed. The internal organs were found. Judging by the absolute age of 29,500 years the Dyukarskaya horse died at the end of Karginsky interglacial. The cadaverous remains are stored in the Museum mammoth IPES Academy of Sakha (Yakutia).

7.5 THE REMAINS OF BISON

The Mylahchynsky bison cadaveric remains were found in September 1971 by A.M. Struchkov on the right bank of the middle reaches of the Indigirka, 45 km below the mouth of the river. Suturuoha near Miahchyn Tracts (Figure 16) on the bison Indigirka disposal site intensively blurs the lofty ridge adjacent to the Alazeya plateau. According to Struchkova over the last 40 - 50 years due to channeling of the Indigirka, shore erosion shifted a 40 – 50 m outcrop whose top 20 – 25 m and a length of about 1 km were piled by a powerful earthy vein of ice wedges. The upper edges of the ice were covered by a thin layer of soil. At the top of the outcrop ice covered about 86 - 85% of the visible area and in the subsurface the ice falls into narrow wedges reaching the water's edge of the river. Ice cores, because of their slow and gradual thawing destruction, protrude from the surface of the earth in columns of 0.2 - 0.5 m in the lower part of the outcrop. In the form of conical pyramids of earth columns (Baydzherahi), is where the preserved remnants of the bison lay in gray loess loam with layers of yellow and gray medium-and fine-grained sand at a height of 1.5 - 3.9 m from the water's edge of the river. At the bottom of the outcrop loamy mass sliding along the inclined surface of icy moist soil were formed sploshnyakom mudflows. Along and on top of the mudflows into the river numerous trunks of trees, shrubs and other plant trash had collapsed.

Excavations determined the podruchpymi bison corpse was in semi-decomposed state, some parts that had moved down the slope landslide had thawed on the surface layers of the host rocks. The bare skull was small within the ruins. Both bare branches of the mandible lay at a 1.5 m height with soft hairs and wool together in a monolith of host rocks. At a height of 2.2 m of frozen soils were fragments of the femoral head and pelvis. The main part of the buffalo corpse laid at a height of 2.6 - 3.9 m in the original grave on its right side, head down the river. The bison torso was dissected at the thoracic vertebrae by a narrow wedge of ice core into two parts. Consequently, the wedging ice core was epigenetically developed after the formation of the deposits and dumping of the bison. On one side (downstream) of the ice core lay the full anatomical sequence including foreleg skin, hair, horny hooves, as well as the forearm, shoulder, scapula, ribs, vertebrae and so on. By the other side of this wall of ice were some ribs, lumbar vertebrae, tail, tibia, astragalus, and poorly preserved remains of the contents of the gastrointestinal tract. At the burial site we collected wool. Some remnants of the corpse were collected together with the enclosing rock monolith.

In all likelihood the Mylahchynsky bison died by drowning in a coastal depression of mud along the Indigirka. On the basis of soft tissue and hair from the bison at the Institute of Geophysics and the USSR (Novosibirsk) radiocarbon dating was set at 29,560 ± 100 years (SB-1007). Consequently the bison died during the Karginsky interglacial with significant climate warming that produced the spontaneous death of the animals and created an environment for the preservation of their bodies for thousands of years.

The corpse of the Mylahchynskogo bison was first kept in Yakutsk in the laboratory mine of the Permafrost Institute SB RAS, and then in December 1973, was delivered to the Biological Institute of the USSR Novosibirsk. In 1974 Professor C.C. Flerov dissected the ovary and determined features of bones that identify the body as a female bison with an age of about two and a half years. The appearance of the Mylahchynskogo bison (Bison priscus occidentalis) was restored by

Flerov (1978). Based on the remaining unchanged coloring of the hair beard, mane, withers, tail, hair on the legs and other parts of the body the external appearance was exactly the same pattern as is present in modern Canadian bison (Bison priscus athabascae). This is not surprising, for the modern Canadian bison is a direct descendant of occidentals, which had in the late Pleistocene a very wide area distribution. With the advent of the Bering land bridge, large numbers of late Pleistocene bison inhabited the vast expanses of the arctic and subarctic regions in Asia and North America. This animal was well adapted to the harsh climate of the forest. These animals eat mostly forest herbs, bark, branches and foliage shrubs. Judging by the pollen presence of flowering sedges and grass contents in the gastrointestinal tract, its habitat, apparently, was the forest valleys of rivers and shores of thermokarst lakes (Ukraintseva, Solonevich, 1978). I think this bison died in the middle of summer, as we found the seeds of cotton grass and sedges. Maybe this animal fell into a swamp as moss is also present in the diverse evidence of significant wetlands at the time of his death.

Thus, at the turn of the Pleistocene and Holocene the continental climate, with its sudden warming adversely affected the habitat of animals on the Asian continent. But in North America due to the mitigating effects of nearby ocean water masses, ecological adaptation of the American bison presumably was not disrupted and they survived these critical climate impacts and persist to the present day.

Conclusion

1. The main natural factors creating paleoenvironmental conditions for mammalian fauna habitat throughout the late Pliocene and Pleistocene are: The climate variations from temperate to sharply colder, continental glaciations development, permafrost and tundra-steppe landscapes of the north, and the spread of coniferous forests in the more southern latitudes. The influence of changing environmental conditions allowed for cold temperature habitat. Anthropogene mammal fauna adapted, in particular, mechanisms of size, thickening of the skin, the development of dense undercoat and hair, and changes to their external bodies. Because of morphological mechanisms of adaptation to the harsh climatic conditions the mammoth fauna in the late Pleistocene reached its peak.

2. The territory of Yakutia from Pliocene to ranneneopleystotsene time is divided into the Lena (WesternYakutia) and the Bering Sea (Eastern Yakutia) zoogeographical provinces. The natural boundary between the provinces is drawn by the Verkhoyansk alpine ridges and Sette-Daban ridges west of the adjacent river valleys of the Lena and Aldan. Fauna of both provinces in their composition differed significantly. The formation of the Lena province took nredkovye form with Euro-Siberian fauna and immigrants from more southern regions of Asia, and the province of Beringia played a decisive role, which, by its peculiar geographical position, became a melange of subarctic fauna.

3. The recording and analysis of the main portions of the osteological material from Yakutia account for the following genera: Mammuthus (27.4%), Equus (26.9%) and Bison (26.8%). Other genera comprise Rangifer (7.6%), Coelodonta (4.9%), Alces (2.1%), and all others (4.3%). These data reflect to some extent the numerical value of various types of mammals that lived in the Quaternary.

4. In examining a large series of osteological material and residues of cadavers from the late Pleistocene the author first made a systematic review of the fauna of large mammals Yakutia. A revision of some taxa justified the allocation of new species and subspecies. In particular, the author highlighted new types of horses Equus (Allohippus) coliemensis and Equus lenensis and justified the selection of the woolly rhinoceros subspecies Coelodonta antiquitatis jacuticus and Coelodonta antiquitatis antiquitatis. On the basis of comparative anatomical analysis of skeletons and corpses, and using radiocarbon dating of new discoveries the author hypothesized that the pozdneneopleystotsene form E. lenensis survived to the present in the form of the Yakut horse. According to the research the corpse of the Mylahchynskogo bison

potverzhdena version, C.C. Flerova determined lived in the late Pleistocene and Holocene in North-East Asia and North America and is identified as Bison priscus occidentalis.

5. The author identified five stages in the formation of large mammal fauna of Yakutia viz., Pliocene - Eopleistocene, ranneneopleystotsene, sredneneopleystotsene, the late pozdneneopleystotsene and the modern. Each stage is characterized by a kind of paleoenvironmental condition and faunal complex. Fauna have been described for seven complexes at specific location references for late Cenozoic mammal fauna.

6. On the basis of geochronological dating, we highlighted two stages of frequent burial sites of cadaver and the skeletal remains of mammals. 1st stage of burial (from 25,000 to 50,000 years ago) is from the Karginsky late Pleistocene era of warming and the 2nd stage is at the beginning of the Sartan - Holocene climatic optimum (about 9,000 to 13,000 years ago). The results of taphonomic studies show that during these time periods the burials of mammals increased due to a wide network of various natural traps, which are associated mainly with climate warming and the development of thermokarst processes and activation of fluvial erosion.

7. Due to the presence of permafrost the author excavated and studied unique burials and skeletal remains and cadavers of mammoth and other extinct animals preserved to the present day. Permafrost established that the remains of soft tissues are preserved up to the present only when there occurs a spontaneous and rapid death of the animal preserving (freezing) them in the ice or frozen soil. The results are studies of skeletal and cadaver residues. The contents of gastrointestinal tracts have provided a pristine appearance of the regularities of extinct animals within the evolutionary process in order to reconstruct the vegetation and climate of the time of their habitat.

8. With the last postglacial stage burials associated extinction of most numerous representatives of the mammoth fauna - mammoths, woolly rhinoceroses, bison and some other mammals were the result of a common cause of global extinction which should be considered a dramatic warming at the end of the Sartan glaciation - early Holocene optimum, causing the transformation of the natural ecological environment. According to our data, in the territory of Yakutia mammoths preserved in the Holocene were adapted to changing environmental conditions. Animals like moose, caribou, perhaps Lena horse, almost all predators, only about 20 species exist today as the results of the work of evolutionary continuity. These representatives of the mammoth fauna will play an important role in the work of resettlement and re-acclimatization of musk ox and bison in Yakutia.

Key provisions of the thesis are presented in the following papers:

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Таблица 10

Крупные млекопитающие антропогена Якутии

ЭОПЛЕЙСТОЦЕН	НЕОПЛЕЙСТОЦЕН										Стратиграфические подразделения
поздний	ранний	средний				поздний				ГОЛОЦЕН	
чукочинский	акинский	тобольский	самаровский	мессовско-ширтинский	тазовский	казанцевский	зырянский	каргинский	сартанский		
1800	800	280				100		50	25	10	Хронология (тыс. лет)
Xenocyon sp. — x											
Gulo minor	*G. cf. schlosseri*	—	—	—		*G. gulo*					
	Homotherium sp. — x										
Felis sp.	*Panthera (Leo) sp.*	—	—	—		*P. (Leo) spelaea*				x	
Ursus sp.	— — —	—	—	—		*U. arctos*					Carnivora
	Canis cf.variabilis	—	—	—		*C. lupus*					
						Alopex lagopus					
						Vulpes vulpes					
Archidiskodon meridionalis	*Mammuthus trogontherii*	*M.trog.* → *M.primigenius*				*M. pr. sibiricus)*				x	
	trogontherii	*chosaricus primigenius*								—	Proboscidea
	Palaeoloxodon ex.gr.namadic. — x										
Equus (Allohippus) verae	*E.(A.) coliemensis* — x										
E. (A) sanmeniensis — x											
	E. nordostensis	*E. orientalis*				*E. lenensis*				?	Perissodactyla
	Dicerorhinus kirchbergensis — x	*Coelodonta antiquitatis* → *jacuticus*				*C.a.antiquitatis*				x	
	Bison sp.	*B. priscus crassicornis*				*B.pr.occidentalis*				— ?	
Praeovibos beringiensis — x						*Ovibos moschatus pallantis*				— ?	
P.cf.priscus — x											
	Soergelia — x										
Praealces — x	*Cervales latifrons*	*C.l.postremus*				*A.alces*					
						Saiga tatarica borealis — x					Artiodactyla
						Cervus elaphus					
						Rangifer tarandus					
						Capreolus capreolus					
						Ovis nivicola					

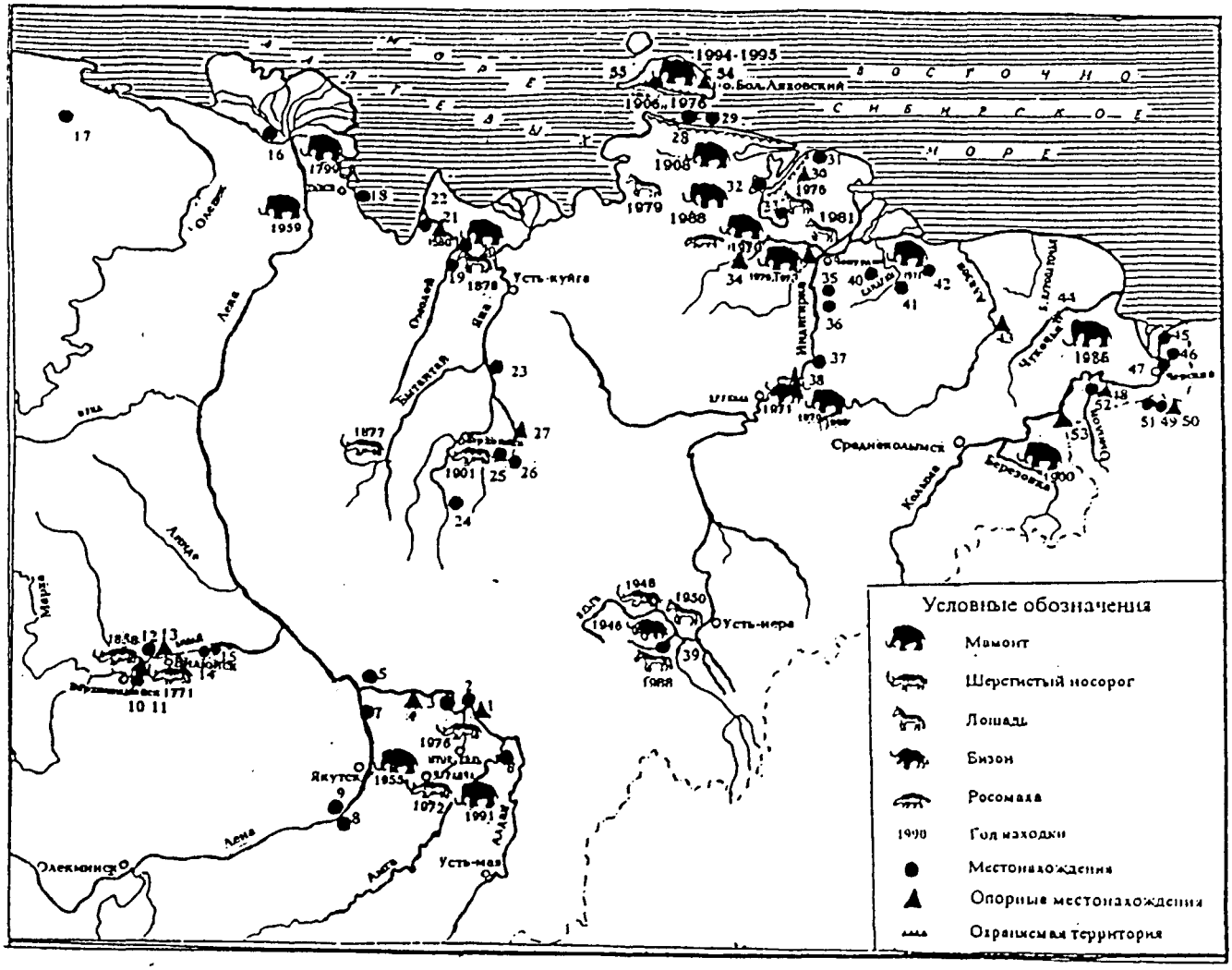
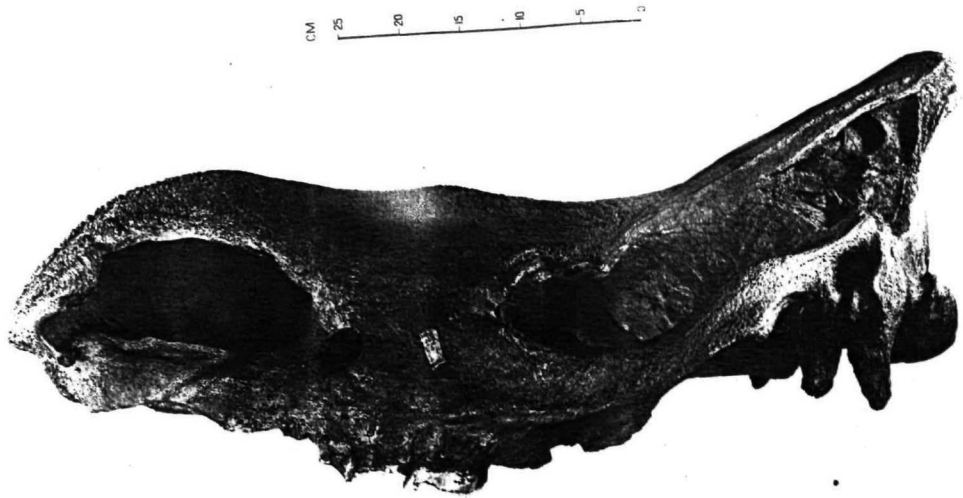


Рис. 7. Карта местонахождений мамонтовой фауны Якутии

1 - Мамонтова гора; 2 - Ихененское; 3 - Россыпное; 4 - Тандинское; 5 - Чуйское; 6 - Чычымах; 7 - Песчаное; 8 - Буотама; 9 - Мохсоголлох; 10 - Верхневилюйское; 11 - Намское; 12 - Тыалычыма; 13 - Чебыда; 14 - Дэлгэр; 15 - Кызыл-Сыр; 16 - Дельта Лены; 17 - Буолкалах; 18 - о.Муостах; 19 - Куччугуй-Кегюлюр; 20 - Бургуат; 21 - Тимирдях Хая; 22 - Эмичи; 23 - Ольджо; 24 - Сартанг; 25 - Борулах; 26 - Оскордох; 27 - Улахан Суллар; 28 - Реброво; 29 - Кондратьево; 30 - Хапташинский яр; 31 - Бигеево; 32 - Кучунной; 33 - Тастах; 34 - Берелех; 35 - Аччыгый Аллаиха; 36 - Бадяриха; 37 - Сыпной яр; 38 - Мылахчын; 39 - Селерикан; 40 - Керемесит; 41 - Шандрин; 42 - Сундрун; 43 - Тумус яр; 44 - Святой нос; 45 - Сухарное; 46 - Горная Филипповка; 47 - Черский; 48 - Дуванный яр; 49 - Молотковский камень; 50 - Уткинский камень; 51 - Константиновский яр; 52 - Сибирское; 53 - Крестовка; 54 - Этерикан; 55 - Зимовье.

Рис.27. МЕСТОНАХОЖДЕНИЯ ОСТАТКОВ НОСОРОГОВ

1



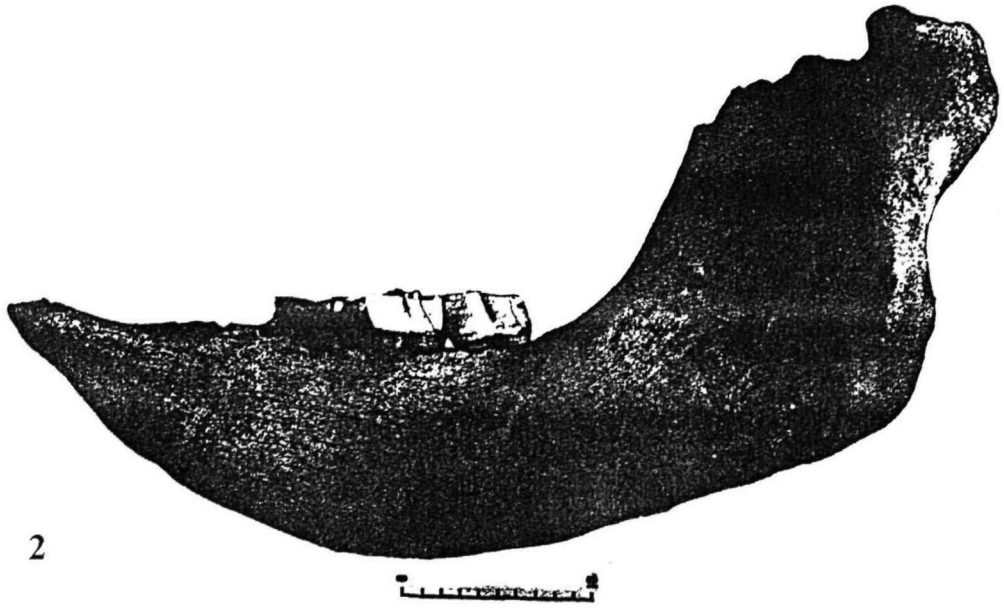
2

Рис. 30. Черепа шерстистых носорогов:

1. C. antiquitatis jacuticus, № 311, ЯНЦ, р. Алдан, 50 метровая, терраса у Мамонтовой горы

2. C. a. antiquitatis, № 104/5, ЯНЦ, р. Алдан, местонахождение Россыпное

1



2

Рис.32. Нижние челюсти шерстистых носорогов (вид сбоку):
1. Coelodonta antiquitatis jacuticus № 400 (ЯНЦ), р. Яна
2. C.a. antiquitatis № 313, р. Алдан, местонахождние Россыпное