

PLEISTOCENE EXTINCTIONS

The Search for a Cause

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Editors

P. S. MARTIN AND H. E. WRIGHT, JR.

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N. K. VERESHCHAGIN

*Zoological Institute
Academy of Sciences of the U.S.S.R.
Leningrad, U.S.S.R.*

PRIMITIVE HUNTERS AND PLEISTOCENE EXTINCTION IN THE SOVIET UNION

Abstract

Archaeological investigations undertaken in the ranges of the U.S.S.R. have yielded very important documentary material for studying the mammalian fauna. In different Pleistocene epochs nearly all the U.S.S.R. was inhabited by the mammoth fauna, characterized by mammoth, cave hyena, cave lion, horse, reindeer, giant and red deer, bison, saiga, etc. In the Russian plain, along the rivers in Siberia, in karst regions of the Crimea, Caucasus, the Urals, Middle Asia, East Siberia, and the Far East, game animals were used by Paleolithic and later tribes. Numerous remains found in the Crimea and in the Ukraine testify to the hunting for large animals.

The largest sites of the Upper Paleolithic are estimated by radiocarbon to be 9,000–14,000 years old.

At the boundary between the Paleolithic and Neolithic, complex changes in the fauna and ecological assemblages of different areas took place. About ten species of large Pleistocene mammals became extinct in the U.S.S.R. Other species underwent a reduced distributional range in the Holocene. Some species, having expanded their range into the taiga, increased their populations (moose, brown bear, beaver). In the Neolithic, man began to exploit fish and marine mammals.

The main reason for the absolute extinction of animals of the mammoth complex and for the reduction of range in some species is the change in climate and terrain, especially the change in the regime of winter weather. The destructive effect of man supplemented and intensified the influence of climatic factors.

As many as two thousand years ago ancient Greek and Roman philosophers wondered how our distant ancestors had mastered the animal world. Titus Lucretius thought primitive man had been a brutal plunderer:

Consectabantur silvestria saecla ferarum
 Missilibus saxis et magno pondere clavae;
 Multaque vincebant, vitabant pauca latebris . . .

De Rerum Natura

This view has been confirmed by abundant archaeological evidence and observations from all continents.

Primitive man penetrated Europe and northern Asia (throughout the U.S.S.R.) from the south with fully formed meat-eating habits and adaptations. The earliest traces of artificial splitting of bones of antelope and deer by pre-Chellean anthropomorphous creatures were found in the upper Pliocene (Villafranchian) deposits of the Black Sea coast and Taman peninsula (Vereshchagin, 1957). In a study of more than 200 Paleolithic and Neolithic nomadic camps in the U.S.S.R. containing Quaternary animal remains, as many as 73 species of animals were found in Paleolithic sites and 60 species in Neolithic (Table 2).

Primitive Paleolithic peoples hunted in general for the mammals listed below. Possibly they also hunted Pisces, Amphibia, Reptilia, Aves, and Insecta, although proof is lacking. As a rule, Insectivora, numerous Rodentia, and birds (especially Passeriformes)—the bones of which were found in the camps of nomads—served as food for owls rather than for primitive man. In the Paleolithic the composition of animals and methods of hunting for them differed to a certain extent from those of western Europe (Lindner, 1937). These differences were caused, in general, by another paleogeographical situation and by its history. The factors of animal extinction there were quite different.

PALEOLITHIC CULTURES

Paleolithic tribes as well as modern ones depended on hunting for their supply of animal food and generally took the most abundant and available animals. The specific assemblage of animals usually reveals clearly the characteristic features of paleo-landscapes of a given region and broadens or defines more precisely our view of the faunistic complexes obtained from studying non-Paleolithic burials. The composition of animals over geographical regions and paleo-landscapes is as follows:

1. *The Caucasian isthmus.* Predominant in the Lower Paleolithic in karst regions were cave bear, red deer, and goat, with lesser numbers of European bison, sheep, boar, horse, rhinoceros, cave lion, leopard, cave hyena, wolf, Siberian red dog, glutton, marmot, porcupine, ape, and salmon. In the Upper Paleolithic, cave bear was hunted only in the mountains. In the foothills of the Caucasus, European bison, goat,

horse, red and giant deer, and boar made up most of the game. Saiga, chamois, and moose occurred rather seldom. Cave hyena, large and small cats, and glutton were very rare. Brown bear began to be hunted (Vereshchagin, 1959).

2. *The Crimea.* In the Lower Paleolithic of the northern Crimean hills game was rather varied, including primarily giant deer, ass, horse, mammoth, saiga, bison, and cave bear; more rarely it included red deer, reindeer, woolly rhinoceros, cave lion, cave hyena, wolf, fox, arctic fox, corsac fox, glutton, European hare, boar, and ibex.

In the Upper Paleolithic, people generally hunted horse and ass. In cave deposits, remains were found of mammoth, woolly rhinoceros, cave hyena, and cave bear, which had nearly vanished by the end of this period. As on the Caucasian isthmus, brown bear began to be hunted (Gromov, 1948).

3. *Russian Plain.* During the Middle Pleistocene there was in the southern part of the plain a huge reserve of large animals nearly untapped by man—"steppe" mammoth, Merck's and woolly rhinoceroses, elasmotherium, horse, ass, and camel (Vereshchagin, 1953). The assemblage of the animals is traced from Mousterian times, i.e. from the beginning of the Upper Pleistocene. At that time ancient inhabitants of the Prut, Dniester, Volga, and Ural river basins hunted in general for horse, bison, mammoth, saiga, and wolf (Pidoplichko, 1954; Panichkina, 1953; Vereshchagin and Kolbutov, 1957; Tchernysh, 1959; David, 1961).

In the Upper Paleolithic, primitive people killed for meat and skins as many as 23 species of animals. In most archaeological excavations the bones and remains of horse, arctic fox, Don hare, mammoth, red deer, reindeer, brown bear, and wolf are the most abundant. The remains of glutton, cave lion, woolly rhinoceros, saiga, tur, bison, and musk-ox, are, as a rule, very rare. Kitchen refuse and other remains of animals are usually mixed with layers of loess-like colluvium in gently sloping ravines opening into river valleys. The Mesin site on the Desna River (Pidoplichko, 1959) and the Kostionki XII site on the Don (Vereshchagin, 1961) indicate the species, which, in varying proportions, are found throughout the Upper Paleolithic. Different indices of the number of any particular species in various nomadic camps are generally explained by the character of accumulation of bone-containing areas, not by differences in the megafaunal complexes or in seasonal or specialized hunting by different primitive tribes. Excavation in the Kostionki XIV site (Fig. 1) revealed dissimilar accumulation of remains in different stratigraphic layers in the Upper Paleolithic. However, some families and whole tribes undoubtedly hunted particular species, especially when conditions

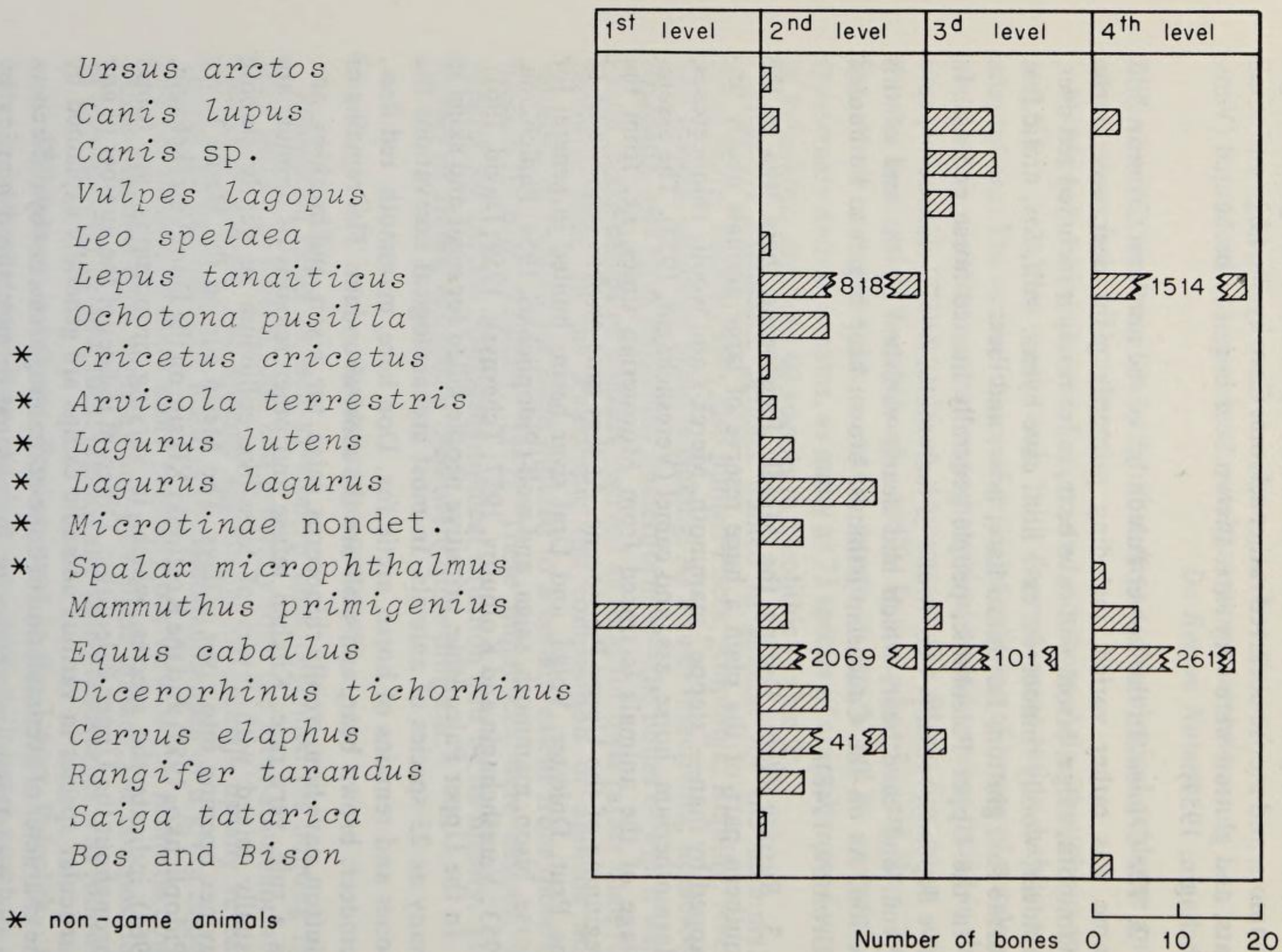


FIG. 1. The specific composition and number of mammal bones found in Paleolithic Kostionki XIV site.

avored such hunting. For example, at the Elsejevichi site (north of Briansk), the hunting of arctic fox, mammoth, wolf, and brown bear prevailed, and ungulates were rare (Fig. 2).

Tundra, forest-steppe, and steppe animals were very abundant, whereas forest and forest-steppe species (brown bear, moose, roe, beaver, and especially lynx, which later became the inhabitant of taiga) were nearly lacking. Very few of these animals existed in the middle belt of the Russian plain in that epoch. True desert inhabitants, such as camel, cheetah, and goitered gazelle, were absent, although in the Mindel-Riss Interglacial large camels were distributed in the Russian Plain up to the latitude of Kazan. Want of skill or desire could not be the reason for specialized hunting. Ancient people of the Russian plain hunted rather successfully for such dangerous and nimble animals as wolf, brown bear, and cave lion. Where there were no cave refuges, they apparently built huts, covered them with skins (Fig. 3), and surrounded them with skulls and bones of mammoths. Excavations revealed about ten species of marine, freshwater, and terrestrial mollusks, which apparently served as decoration (Shovkoplias, 1965).

In the middle belt of the plain, tribes specialized exclusively in the hunting of reindeer or bison. In the valley of the middle course of the Bug, Dniester, Dnieper, Don, Volga, and Ural rivers, various animals were hunted. However, on the Black Sea coast, tribes generally hunted bison. The fate of these bison hunters is unknown.

In the Upper Paleolithic, primitive tribes pursued mammoth, horse, and reindeer far north to the low reaches of the Pechora, latitude 65–80°N.

4. *The Ural Mountains.* The people lived here in foothill caves and hunted cave bear, reindeer, moose, wolf, glutton, sable, mammoth, woolly rhinoceros, and willow grouse. Roe and saiga, though very rare, penetrated north to the upper reaches of the Pechora during the development of steppe terrains (Vereshchagin and Kuzmina, 1962; Guslitzer and Kanivetz, 1965).

5. *Middle Asia.* In foothill Paleolithic camps near Samarkand, the remains of horses, ass, red deer, camel, and tur were found. In the spurs of the Gissar ridge (the Mousterian sites Aman-Kutan and Teshik Tash) the usual game were mouflon, Siberian ibex and roe, Buchara deer, brown bear, cave hyena, leopard, fox and wolf, marmot, porcupine, and Horsfield's terrapin (Bibikova, 1958; Gromova, 1949).

6. *Eastern Kazakhstan and the Altai.* In the Upper Paleolithic, primitive man hunted horse, bison, Pamir argali, mongolian ass, Baikal yak,

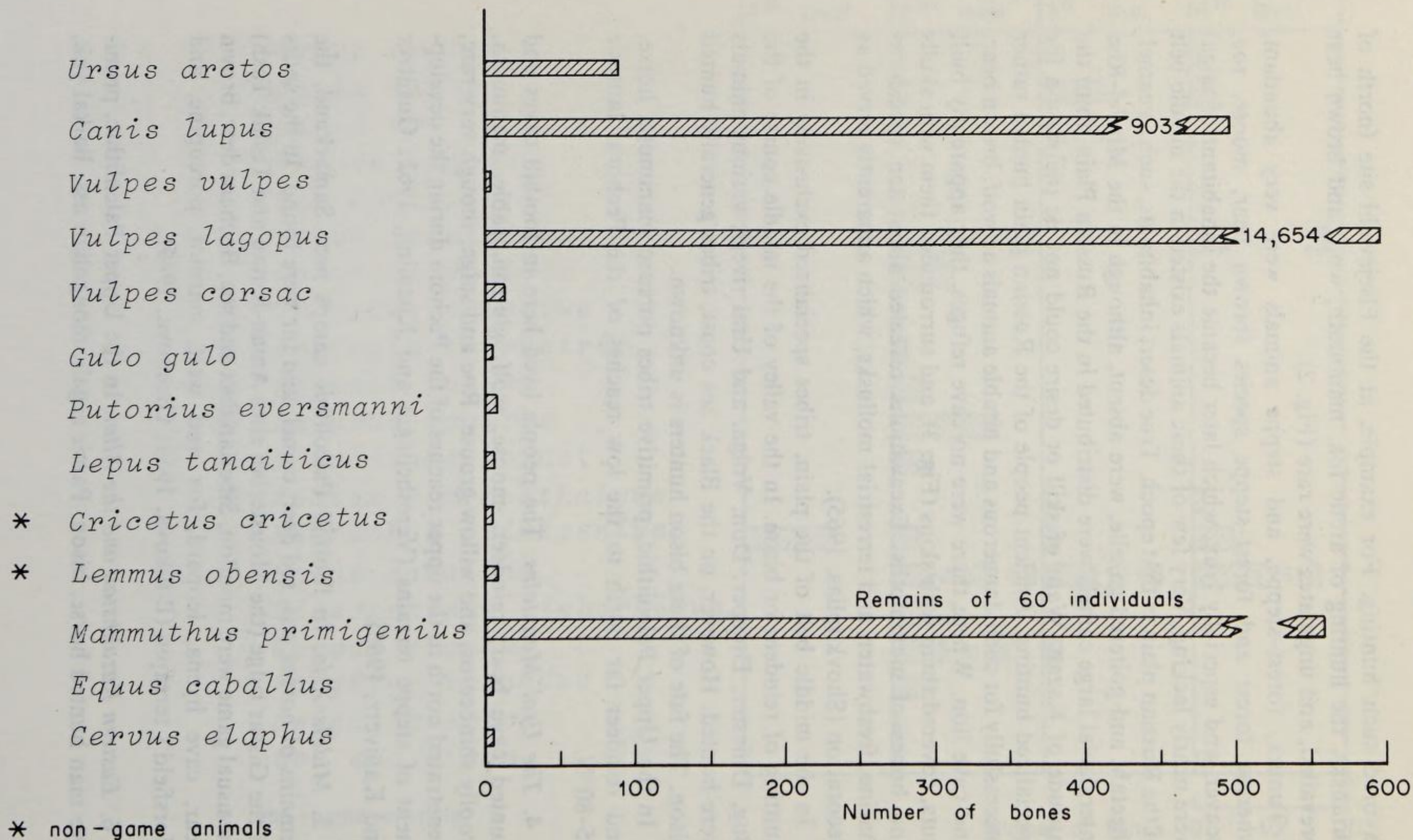


FIG. 2. The specific composition and number of mammal bones found in Paleolithic Elissejevichi site.

camel, antelope (*Spirocerus*), brown bear, roe, rhinoceros, mammoth, heath cock, and snow cock (Vereshchagin, 1956).

7. *Eastern Siberia and southern Yakutia.* In the Upper Paleolithic along the Yenisei River and its tributaries and along the Angara, primitive

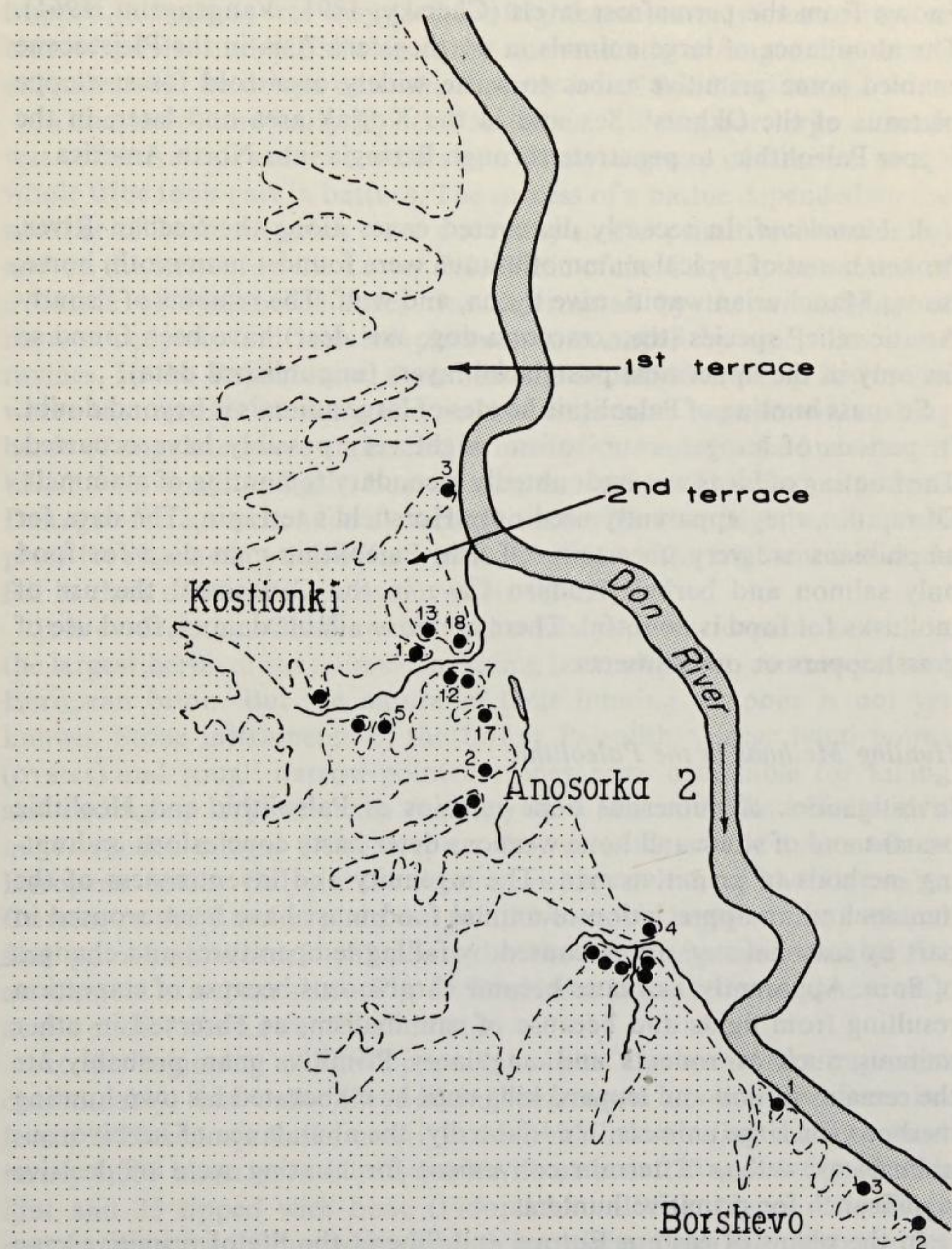


FIG. 3. The scheme of location of Upper Paleolithic camps on the Don south of Voronezh (according to Rogachev, 1957).

man hunted mostly reindeer, horse, primitive bison, Arctic fox, blue hare, woolly rhinoceros, and mammoth. In the valley of the Angara River fowling was quite common (Gromov, 1948). The composition of animals killed by ancient inhabitants of Yakutia has not been investigated well, but it is thought to be close to the complex of large animals known from the permafrost levels (Chersky, 1891; Vangengeim, 1961). The abundance of large animals in northeastern Asia in the Pleistocene enabled some primitive tribes to settle widely over cold forest-steppe plateaus of the Okhotsk Sea and in the Korjak area and later, in the Upper Paleolithic, to penetrate through Beringia into North America.

8. *Ussuriland*. In recently discovered caves along the Suchan River, broken bones of typical mammoth fauna were found—mammoth, horse, bison, Manchurian wapiti, cave hyena, and wolf. The remains of “south-Asiatic relic” species (tiger, raccoon-dog, axis deer) have been found so far only in the uppermost postglacial layers (unpublished data).

So mass hunting of Paleolithic hordes of large animals is beyond doubt. In periods of hunger, cannibalism might very possibly have occurred. The hunting of birds was undoubtedly secondary to hunting of mammals. Of reptiles, they apparently used only Horsfield's terrapin. The data for amphibians are very uncertain. Of fish, Paleolithic man used for food only salmon and barbel (Kudaro Cave in the Caucasus); the use of mollusks for food is doubtful. There are no available data on food use of grasshoppers or other insects.

Hunting Methods in the Paleolithic

Investigations of numerous bone remains of Paleolithic and Neolithic hearths and of stone and bone weapons deter hasty conclusions on hunting methods of primitive man. The ingenuity and inventiveness of the hunters and an appreciation of animal food must have been aroused in part by seasonal starvation, caused by falling temperatures and changes of flora. Apparently, primates became carnivorous because of starvation resulting from fights and because of cannibalism, as observed in other animals, such as rodents and ungulates. Primitive man probably ate the remains of lion and leopard kills until he elaborated his own hunting methods for large animals. Undoubtedly, the abundance of herbivorous animals as well as a terrain convenient for hunting were of decisive significance for primitive hunters.

In the plains of eastern Europe and Siberia the life of primitive man was connected with river valleys. Large herds of mammoth, rhinoceros, roe, giant deer and reindeer, and boar roamed from south to north

and back along the valleys and floodplains of the rivers. The inhabitants of steppe watersheds preferred meadows and forests of floodplains, especially in dry periods or when the ground was covered with ice crust, because then elk, bison, tur, horse, and even saiga and camel fed upon branches of bushes and trees. It was possible to find animals trapped in bogs. It was easy to drive frightened animals into ravines or narrow pools, and pitfalls could be conveniently arranged. In winter animals could be driven onto the slippery ice of floodland lakes.

In the lower and early-Upper Paleolithic, hunting for large animals was collective. All active members of a family, a group of families, or the whole tribe took part in battues. The success of a battue depended on the number of beaters (which were not many in the primitive community) and on the terrain. In the Lower Paleolithic of the Crimea, the success of a battue of Pleistocene asses was determined by the availability of narrow canyons and isolated plateaus surrounded by steep limestone ravines. In the Bakhchisarai area near the Mousterian camp Staroselje, where the remains of many hundreds of asses have been found, rushing herds of ungulates were ambushed in narrow canyons by the hunters and killed with stones, cudgels, boar spears, and spears. The pasture plateau Dzhugut-Kala, surrounded by vertical ravines 30–40 m high, was an ideal place for regular hunting of herbivorous animals. The frightened animals fell to their death into the ravine (Fig. 4).

It is evident that Chellean and Acheulian man was capable of killing the largest herbivorous animals including bear, elephant, rhinoceros, and European bison. But the nature of their hunting weapons is not yet known. Stone instruments of the Lower Paleolithic, large hand points (ovates) and rough narrow-pointed stones, were unsuitable for killing and cutting up large animals. A sleepy cave bear could be killed with a huge wooden cudgel or boar spear, but certainly not a mammoth or European bison. Only in the Acheulian-Mousterian of the Caucasus, Crimea, or the Russian plain did primitive people begin to use flattened flint points, sometimes with barbs on the back edge and suitable for attachment in a spear shaft (Fig. 5). Darts also began to be used here only at the end of the Lower Paleolithic.

At the beginning of the Upper Paleolithic the spear was improved considerably, but collective hunting continued to develop. Remains found in Kasennaja balka near Amvrosievka indicate that during a hunt nearly 1,000 bison were run through with at least 270 spears tipped with flint and 35 tipped with bone (Pidoplichko, 1953). Upper Paleolithic people undoubtedly hunted mammoth by driving them into deep ravines with sheer walls, which are common in deep loess areas of the first steppes around the Black Sea coast.

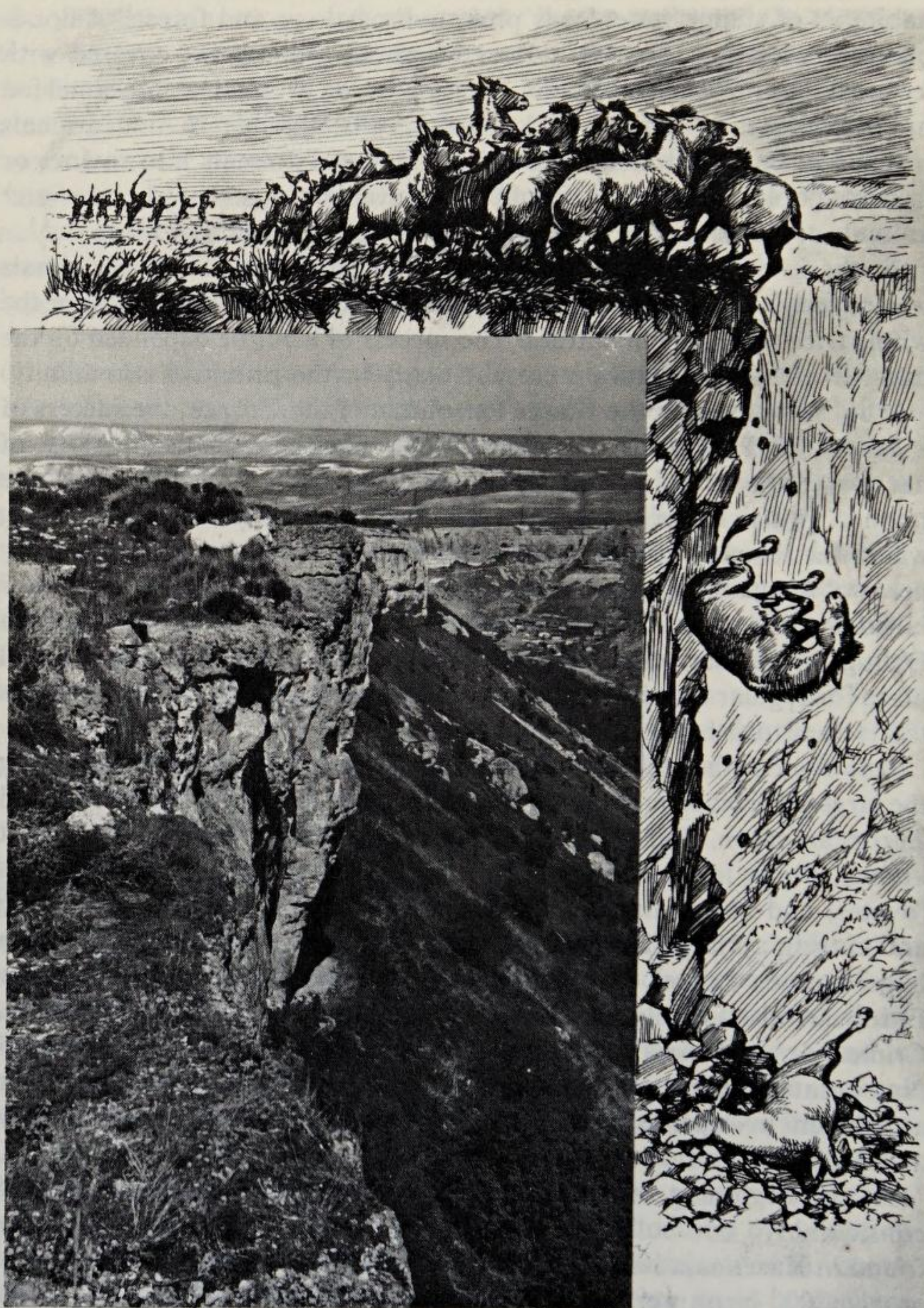


FIG. 4. The ravines of Dzhugut (Tchufut)—Kala, a probable hunting site for Pleistocene asses (photo by N. K. Vereshchagin, 1959).

In Siberia, primitive hunters obtained reindeer meat, skins, tendons, and horns during the migrations of thousands of herds, like those at the Angara River and near the Malta site on the Birjusa River.

Deer, arctic fox, hare, and willow grouse were undoubtedly known to man during the Upper Paleolithic, but whether they were trapped is not clear. Ungulates and even large predatory animals could be caught by means of strap loops with a hanging device. Data are lacking in both the Lower and Upper Paleolithic on the use of fire and torches as well as fences and nets in hunting.



FIG. 5. Flint head of a dart from Upper Paleolithic Kostionki site (according to Rogachev, 1957).

Hunting for large animals contributed to the growth of collective habits and to a feeling of interdependence among primitive peoples. The spear, the main weapon in the Upper Paleolithic, was improved with better flint and bone heads and a shaft. Small straight birch, pine, juniper, and fir trees, found nearly full grown along the banks of rivers and lakes, were apparently used for spear and dart shafts.

The flint head was improved through flattening, the reduction of the cross-sectional area, and the strengthening of the working edges by retouching. The main technical qualities of the flint head, i.e. the thickness and angle of the cutting edge, were elaborated by primitive masters as early as the Upper Paleolithic and remained unchanged until the Bronze Age. Evidently nothing better could be attained with this material (Fig. 6). The angle of the working edge along the first 10–12 mm of the

blade was about 36° to 38° in both early and late heads. In the most thoroughly chipped heads the angle was reduced to 27° (Fig. 6).

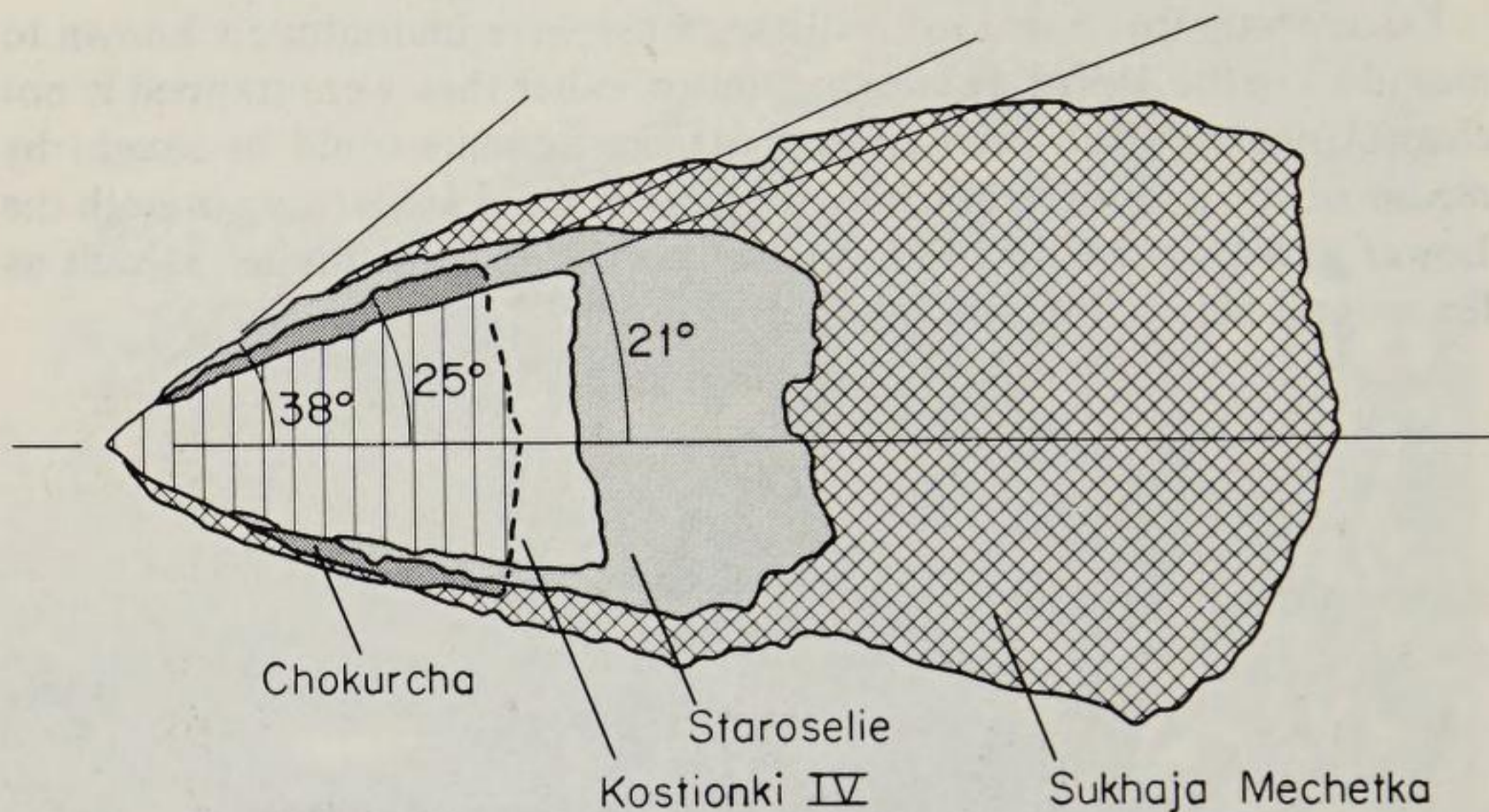


FIG. 6. The outlines of flint heads of darts from Mousterian and Upper Paleolithic sites of the Russian plain.

Narrower bone heads were prepared from reindeer horns and bison metapodials and were sometimes supplemented with cutting flint plates fastened to the heads. Besides increasing cutting ability, these plates kept the spear embedded in the wound and thus intensified bleeding (Fig. 7).



FIG. 7. Dart head made of horn wall of reindeer with longitudinal slots; Upper Paleolithic camp on the Yenisei River.

The invention of a light missile dart created unlimited possibilities for hunting the largest and most dangerous animals by one or several hunters. Collective driving of animals over a precipice or into an ice crevasse or a bog was not necessary if such darts were available. A spear thrown 20 to 30 meters by a skillful hand could pierce the pectoral wall between ribs and reach the vital organs. By piercing and tearing the abdominal wall near the groin a running animal might be disemboweled. The supposition is borne out by the well-known drawing of a disemboweled European bison on one of the walls of the Lascaux Cave in the Dordogne (Fig. 8).

In the U.S.S.R. and elsewhere, there are many descriptions of large animal bones that were pierced with flint, bone spear heads, or darts (Fig. 9). Injuries caused by such weapons are evident in the condition of certain fossil bones (Tasnadi-Kubacska, 1962).

Specialized hunting of mammoth in the Upper Paleolithic of the Russian plain probably followed closely the invention of a narrow flint tip capable of piercing the abdominal wall of elephant and rhinoceros.



FIG. 8. A dart pierced the abdominal wall of the primitive bison; Lascaux Cave, Dordogne, France.

In the Ukrainian Upper Paleolithic, hunters prepared large cutting instruments made of chalky flint, as is indicated by findings in Novgorod-Seversk on the Desna River. These gigantic flint weapons (Pidoplichko, 1941), 12×45 cm and 4–8 kg, could be used as axes for cutting meat. Their marks can be seen on mammoth bones. These flint axes, fastened to a long shaft, could be used for finishing off large wounded animals. Many hundreds of broken, and less often unbroken, bones and dozens of mammoth skulls as well as peculiar blocks of these bones are found in the Upper Paleolithic camps of the Russian Plain. They have caused bewilderment and misunderstanding among zoologists and archaeologists. The blocks were usually described as remains of huts (Fig. 10).

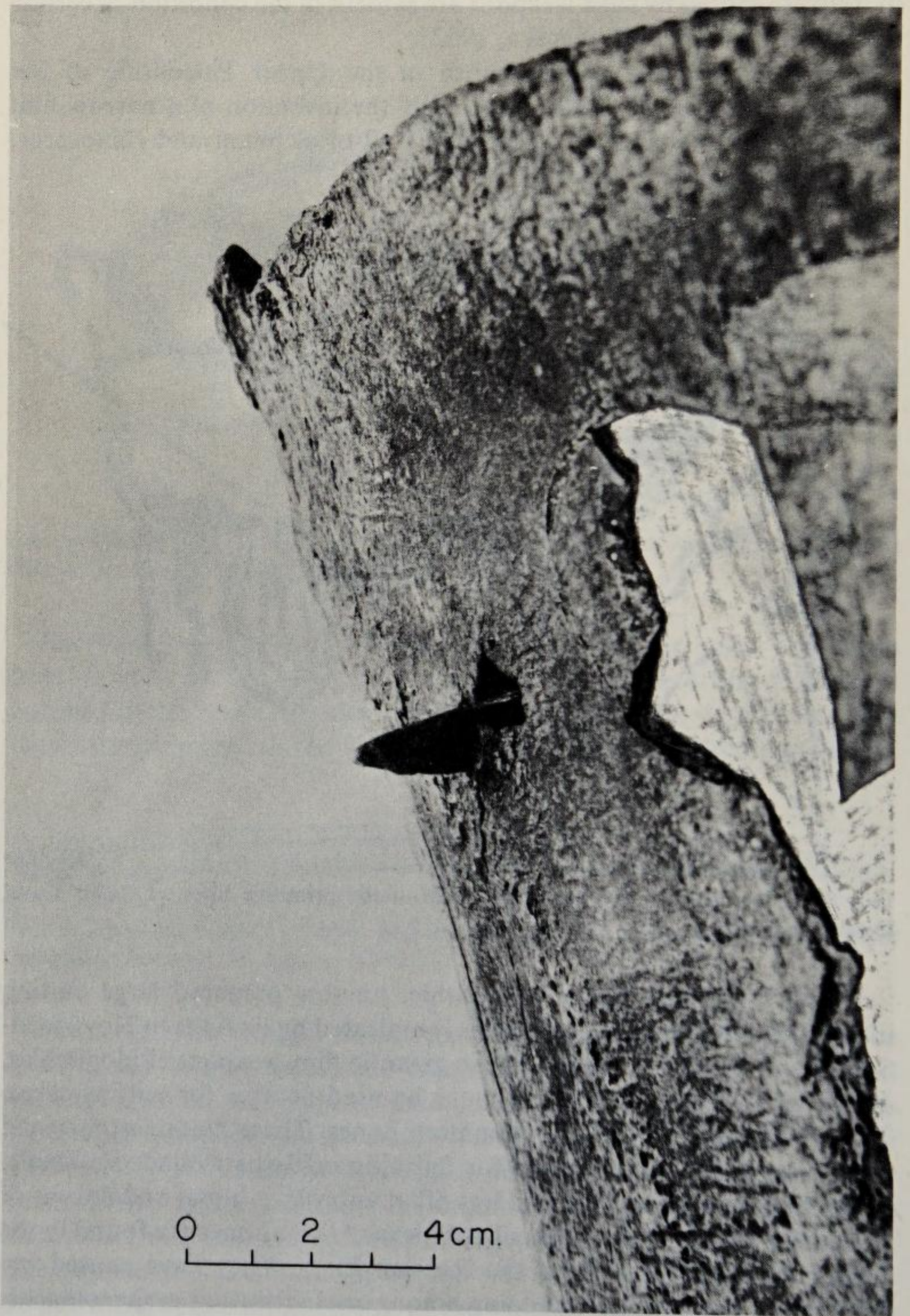


FIG. 9. A dart head made of reindeer horn went through the shoulder blade of the bison; camp on the Yenisei River.

Without spades for digging large pits or metal spear heads for cutting the Achilles tendon or piercing the pectoral or abdominal wall, it is not definitely known how hunters could have killed mammoth and rhinoceros. Russian paleontologists and artists have unsuccessfully attempted depictions of the armament of primitive man and hunting for mammoth and other thick-skinned animals by means of pitfalls and stone darts (see frieze, "Stone Age" by Vasnetsov, 1956, the pictures preserved in museums, and illustrations in certain papers).



FIG. 10. Blocks of bones and skulls of mammoths in the Mesin site, the Desna River (photo by N. K. Vereshchagin in 1956).

Some paleontologists and archaeologists (see Gromov's review, 1948) have made the valid suggestion that Upper Paleolithic hunters generally used the carcasses of mammoth that had died in floods or from some other natural cause.

Artificial hills of mammoth skulls and bones found along the Don, Desna, and Dnieper rivers (sites of Kostionki, Mesin, and Kirillovskaja, among others) might originally have been mounds around Paleolithic huts, or ritual hills. Maceration of carcasses must have required several years, however, and a decaying mammoth carcass certainly would not have been suitable for mounds near wigwams. Alternatively, such accumulations could have been formed after spring floods in ravines near the western high banks of the rivers.

The cleaned and dried skull of an adult mammoth with small tusks weighs at least 100–110 kg, so that dragging it even over ice for several kilometers would have been quite difficult. A lower jaw of an adult Indian elephant (and mammoth) weighs 30–35 kg. Thus the construction of such mounds could have taken place only if there was an abundance of bone material, which would suggest animal epizooty caused by natural calamities.

Kornietz (1961), who examined bones on the Mesin site, claims, without going into details, that primitive hunters actively hunted mammoth and destroyed whole herds on occasion. Usually, communities of hunters armed with spears hunted for solitary mammoth or small groups of females with young, as African Negroes now hunt elephants. The hunters pierced the abdominal wall of the mammoth and then pursued them, sometimes for many kilometers; but hunters could obtain only single specimens at a time. They hunted woolly rhinoceros in the same manner.

Along the river valleys of the Russian plain, hunting for Proboscidea and ungulates was especially successful when the ground was firmly covered with frozen snow crust. Animals, weakened by lack of food, gathered in the forests or brush of floodplains, where they were killed with spears and cudgels.

The best account of the evolution of hunting and weapons in the Paleolithic is given by the archaeologist Zamiatnin (1960). Data on hunting methods in the Paleolithic for ungulates, Proboscidea, and predators in various regions of the U.S.S.R. are still fragmentary and speculative. It is difficult to calculate the number of animals killed, even if they were butchered and eaten in the same place; leavings were usually thrown away, pilfered by predatory animals, decomposed, or washed away. Therefore, the numbers of animals given in Table 1 might be at

TABLE 1. The Number of Killed Animals, as Indicated by Remains Found in Some Camps and Slaughter Areas

<i>Sites</i>	<i>Number of Animals</i>
Amvrosievka ravine, South Ukraine	1,000 bison
Staroselje site in the Crimea	435 asses (at least 1,200 over the whole territory)
Mesin site on the Desna River	44 mammoths
Elissejevichi site of the Briansk region	60 mammoths 285 arctic foxes
Anosovka II site on the Don River	32 mammoths
Kostionki XIV site on the Don River	500 hares 120 horses

least tenfold greater, if the one- to two-year existence of each camp is kept in mind. According to our observations in modern open camps of fishermen and hunters, with dogs, cats, and magpies, no more than 1 per cent of the cleaned bones remain or are trampled into the soil layer. In Paleolithic camps, leavings were pilfered by arctic foxes, rodents, and birds. Within the U.S.S.R., however, no camps have been found with as great a number of bone remains as in those of western Europe.

In the Paleolithic, as in the present, many more animals were killed than were needed. In Amvrosievka, for instance, if a stampede was successful, the hunter used only the uppermost few bison out of several dozens of animals that fell into the ravine. The same was true of the slaughtered herds of horses, asses, reindeer, and mammoth.

The human population of the Crimea and Russian Plain in the Upper Paleolithic hardly exceeded ten to fifteen thousand. For their frugal feeding (2 kg per day = Eskimo ration; see Mowat, 1963) they needed about 120,000 reindeer, 80,000 horses, 30,000 bison, or 10,000 mammoths (mainly semi-adult beasts) per year. The absolute number is not relatively high, as the herds of different ungulates in the Pleistocene probably consisted of hundreds of thousands of head, but the effect of primitive hordes upon the animal world went far beyond the destruction of large animals for basic needs. Dwelling near the habitual watering places or near migration routes of large animals, primitive people often disturbed the behavior pattern of large herds and consequently might have unintentionally caused death among the animals.

Bone layers in ancient alluvium of the Volga, Ural, Indigirka, Viluj, and Kolyma rivers indicate that natural mortality (often caused by disaster) of large animals in the Pleistocene was sometimes enormous. According to my calculations in 1949-51 on bone-bearing beaches of the lower Kama, middle Volga, and lower Ural (Mysy, Undory, Tungus, Janvartzevo, and others), only 0.1 to 0.5% of Pleistocene bones bear the traces of artificial marks or splits made by flint spears. Presumably, most animals died independently of man. Recent examples (e.g. Pannonik lowland) seem to indicate that natural animal deaths were caused not only by snowfalls or by the lack of food but also by vast autumn and spring floods.

The Use of the Carcass

After a large animal was killed, the main operations were to flay the animal, take out choice pieces, especially the liver, and cut flesh from the skeleton. For this purpose, primitive men used flat flint or obsidian tools with thin, sharp blades. Less suitable were knife-like plates, leaf-like

points, and chisels blunted by retouching. The traces of cuts on bones show that, for flaying and cutting, primitive people generally used large fragments of cores and knife-like plates rather than finished instruments. Cuts made by them are pure and straight, without the lateral parallel lines that are inevitable when a retouched blade is used for cutting. Used and blunt blades were thrown away.

There are no trustworthy data available on preservation of meat by sun-drying or by smoking. However, in frosty periods, meat reserves could remain in caves and pits for several months, and in permafrost regions for hundreds of years. Primitive hearths contain animal bones intentionally smashed with stones for the extraction of the marrow (Fig. 11). Animal carcasses were also used in different ways; e.g. large animal



FIG. 11. Phalange of red deer, smashed for the extraction of the marrow; Fatma-Koba Cave in the Crimea (drawing by N. K. Vereshchagin).

skins were apparently used for lining huts and covering roofs. Strips were apparently cut from the skins of horses and deer for nooses; tendons were used for sewing clothes and blankets made of skins of deer, hare, and arctic fox. Bones and skulls of mammoths were used for strengthening mud huts (Rogachev, 1955) and for the construction of funeral chambers (Boriskovsky, 1956) and sacrifice hills (Fig. 12).

Bones of mammoths were good fuel, as suggested by charcoal found in Chokurcha and Kostionki sites. Tusks were used for making knives, awls, and needles, and molars were used for smashing bones. Needles and awls were made also of splint bones of horses and of the femur, tibia, and



FIG. 12. Block of bones found in camp Anosovka II. Lower jaws of mammoths (photo by N. K. Vereshchagin).

capral bones of arctic fox. Thin needles were cut from radial bones of arctic fox and tusks of mammoth. Mammoth tusks and cylindrical bison bones, as well as reindeer horns, served as spear tips and darts (Fig. 7). Necklaces, bracelets, pendants, and decorations on leather cloaks were made of drilled fangs of arctic fox, of incisors of wolf, beaver, and saiga, of mammoth tusks and sometimes of seashells (*Buccinum superabile*, *Cerithium vulgatum*, and *Nassa reticulata*). Bones and skulls of some animals were used as fetishes and luck charms for ceremonial rites. In the Kostionki IV site, skulls of cave lions were found on the roofs of some huts (Rogachev, 1955) or in ritual bone hills.

Animals and Art of Paleolithic Man

Within the U.S.S.R., animals were the main subject of primitive imitative paintings. Their images are represented in sculpture and in drawings of the Upper Paleolithic of the Russian plain, Urals, and Siberia.

In all, there were recorded thirteen species of realistically portrayed animals or of their heads. The most common are drawings of bear, cave lion, bison, musk-ox, camel, mammoth, and horse. Figurines closely resemble birds (Mesin site), including flying geese (Malta, Buret sites) (Avramova, 1962; Shovkoplias, 1965). Bone, marl, limestone, clay, and probably wood were used for pieces of sculpture, but such artifacts have disappeared. The most expressive art works are sculptural portraits of cave lion and cave bear. Animals were drawn on stones, tusks of mammoths, and walls of caves (Kapova Cave, southern Urals, Fig. 13).

The walls of Kapova Cave have very interesting drawings representing mammoth and rhinoceros in ocher (Bader, 1963). Sometimes such drawings on rocks and figurines had a ritualistic meaning, especially in the Neolithic (Bader, 1941, 1954).

NEOLITHIC CULTURES

The transition from the Paleolithic to the Mesolithic and then to the Neolithic and metal cultures throughout the U.S.S.R. is accompanied by a further improvement of hunting weapons. The pressure of human tribes upon the animal world continued to increase in spite of the appearance of domestic animals (dogs, horse, pig, goat, sheep, and cow). The invention of the bow, boat, net, snare, trap, hook, and harpoon and the use of dogs and horses for searching out, impounding, and driving animals created new possibilities for hunting fur-bearing animals and wild ungulates and for exploiting untapped resources of fish, seals, whales, and other marine animals (Fig. 14).

Individual weapons, especially the spear, continued to improve in the Neolithic. Archaeologists, however, have not been able to explain the displacement of large flint weapons of the Paleolithic by microliths in the Mesolithic. Among numerous microlithic weapons found in steppes on the northern border of Caspij, only small arrow points were suitable for hunting. The possibility that flint tips of spears and darts replaced bone and horn tips during that period is increased by the fact that polished axes were already made of slate and nephrite, which yielded easily to treatment.

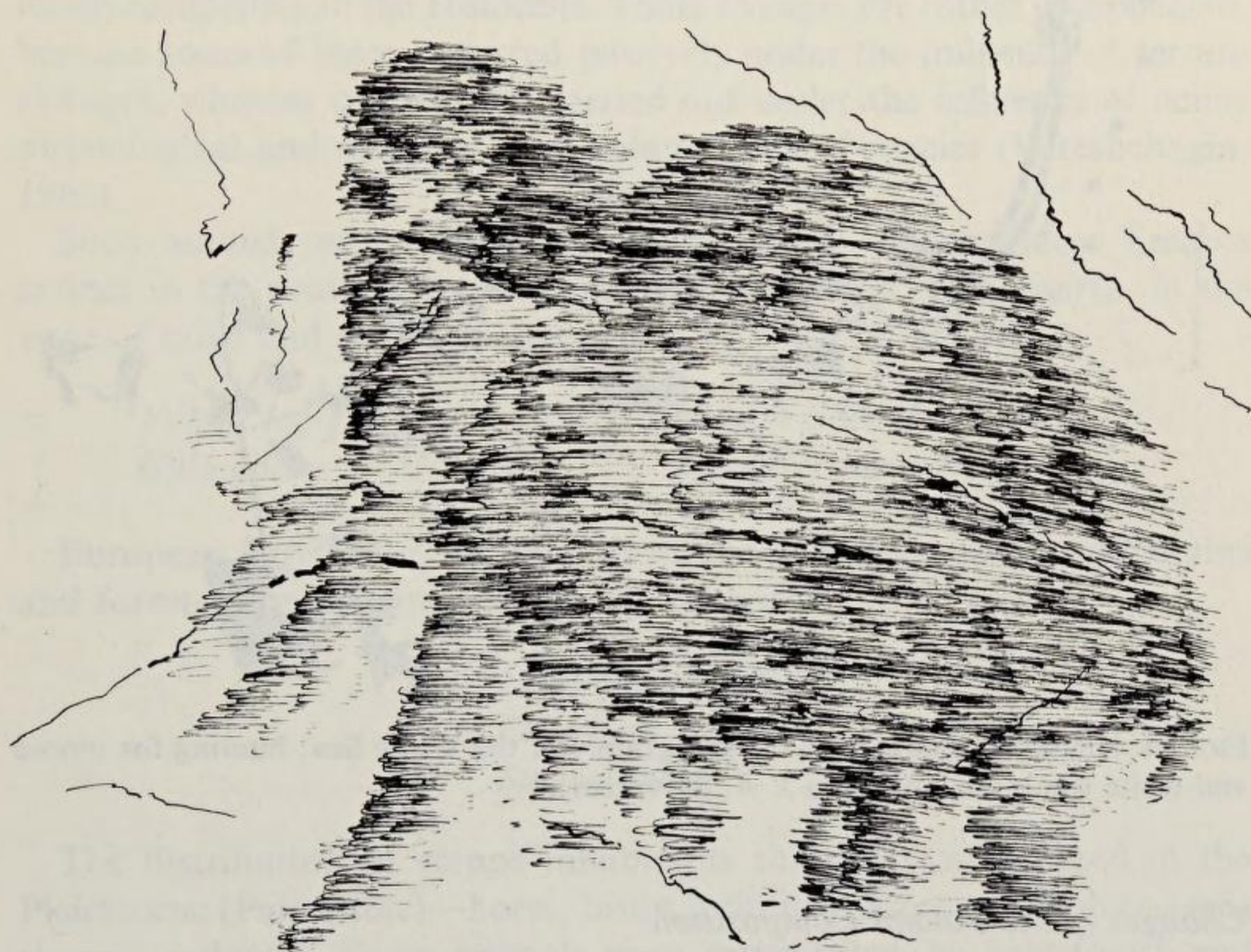


FIG. 13. Paleolithic drawing made with ocher on the wall of Kapova Cave (according to Bader, 1963).

In the Neolithic and post-Neolithic the number of drawings on rocks in taiga, steppe, and desert zones increased. There are published and partially studied Neolithic drawings on the rocks of Lake Onega and the White Sea (Ravdonikas, 1936-38; Kühn, 1956), in the Ukraine (Bader, 1941), in Transcaucasia (Vereshchagin and Burchak-Abramovich, 1948), in Ciscaucasia (Markovin, 1958), in Middle Asia (Grach, 1957; Marikovsky, 1953; Sokolov, 1964); and in eastern Siberia (Grach, 1957; Rygdylon, 1955; Skalon, 1956; Okladnikov, 1959). As in the

Paleolithic, the cave paintings are presumed to represent animals and hunters. The specific composition of animals in these drawings resembles, as a rule, the zoogeographical pictures of today.

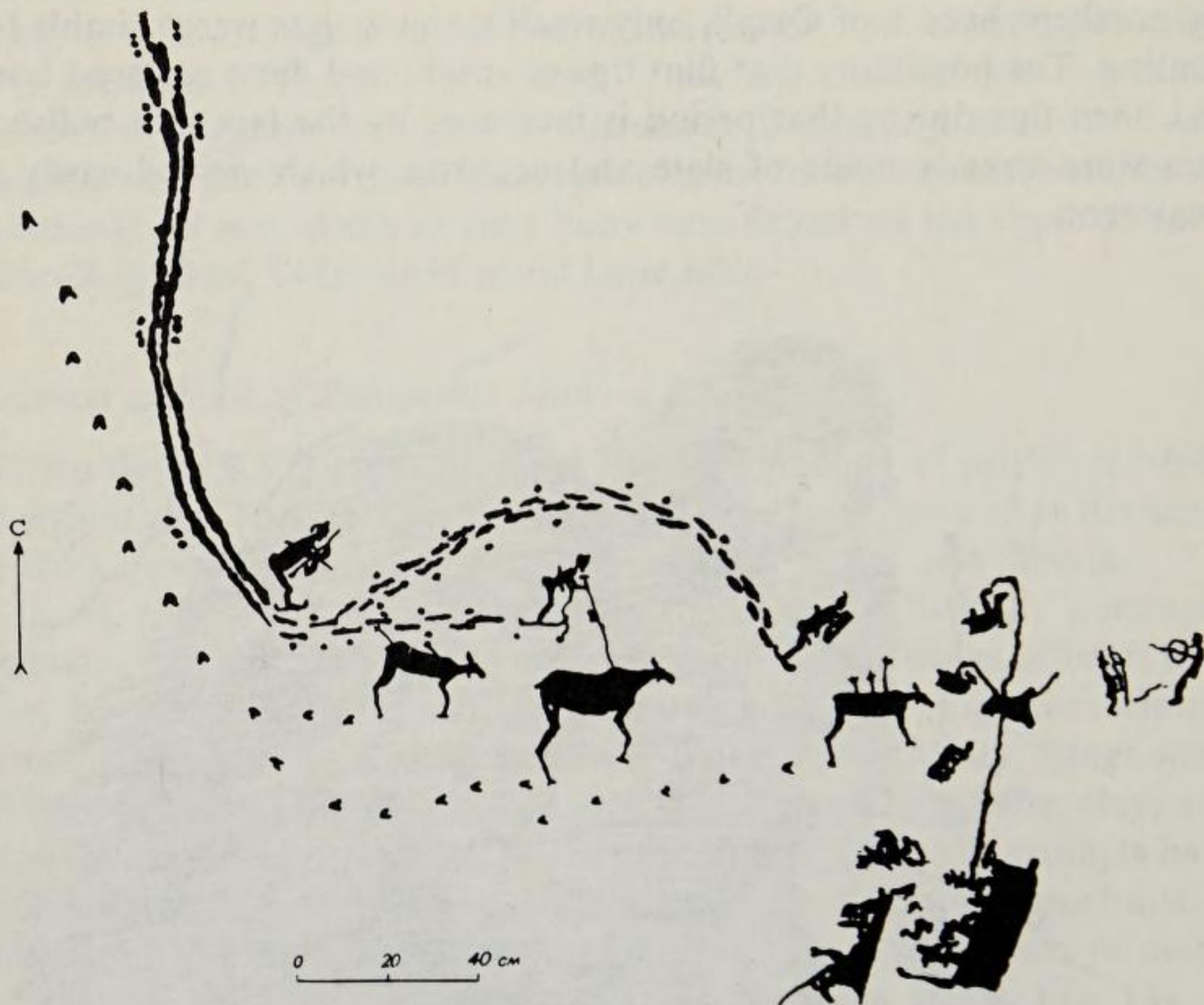


FIG. 14. Neolithic drawings on coastal granite of the White Sea; hunting for moose and white whale (according to J. A. Savvateev).

Changes in the Faunal Composition

Throughout northern Asia, the composition of animals changed considerably at the boundary of the Paleolithic and the Neolithic (Table 2, below). The main faunal changes are listed below. Throughout the U.S.S.R. a large group of animals of a typical upper-Pleistocene mammoth complex became extinct:

Ursus spelaeus

Crocota spelaea

Leo spelaea

Mammuthus primigenius

Lepus tanaiticus

Dicerorhinus tichorhinus

Equus hydruntinus

Capra sp. (prisca?)

Ovibos moschatus

Spirocerus kjachtensis

Poephagus baicalensis

Nevertheless, many Pleistocene species withstood the increasing influence of man and passed into the Holocene with ecological and morphological changes. They include, for instance, cosmopolitan carnivora and some ungulates:

<i>Canis lupus</i>	<i>Capreolus</i>
<i>Vulpes vulpes</i>	<i>Cervus elaphus</i>
<i>Ursus arctos</i>	

Some game animals, having survived the Pleistocene, changed their locale completely in the Holocene. These changes are rather complicated, because some of them occurred passively under the influence of terrain changes, whereas others were carried out under the influence of active physiological and morphological adaptations of species (Vereshchagin, 1963).

Such animals as arctic fox, glutton, beaver, and reindeer became extinct in the south but were quickly acclimatized in the north, in the zone of taiga and partly of tundra:

<i>Vulpes lagopus</i>	<i>Castor fiber</i>
<i>Gulo gulo</i>	<i>Rangifer tarandus</i>

European hare, boar, and lynx from the zone of southern mountains and forest-steppes ranged farther to the north:

Lepus europaeus
Felis lynx
Sus scropha

The distribution of steppe inhabitants that were widespread in the Pleistocene (Paleolithic)—horse, bison, primitive tur, and red deer—was sharply reduced. These animals were represented by new forest and steppe forms:

<i>Equus caballus</i>	<i>Bison priscus, B. bonasus</i>
<i>Bos primigenius</i>	<i>Cervus elaphus</i>

Corsac fox, camel, saiga, and sheep receded into steppes, plateaus, and mountains of central Asia:

<i>Vulpes corsac</i>	<i>Poephagus baikalensis,</i>
<i>Camelus knoblochi, C.</i>	<i>P. gruniens</i>
<i>bactrianus</i>	<i>Ovis gmelini, O. cicloceros</i>
<i>Saiga borealis, S. tatarica</i>	<i>Ovis ammon</i>

In the Holocene, the southern limits of the U.S.S.R., the Caucasus, Central Asia, and Ussuriland were inhabited by new species of south-Asiatic origin: jackal, raccoon dog, striped hyena, lion, tiger, wild ass, axis deer, and goitered gazelle:

<i>Canis aureus</i>	<i>Panthera tigris</i>
<i>Nyctereutes procyonoides</i>	<i>Equus hemionus</i>
<i>Hyaena hyaena</i>	<i>Cervus nippon</i>
<i>Leo leo</i>	<i>Gazella subgutturosa</i>

Not only the distribution but also the number of large animals changed greatly. Populations of brown bear, beaver, boar, lynx, blue hare, roe, and especially of moose increased in the Holocene to such an extent that

<i>Ursus arctos</i>	<i>Sus scrofa</i>
<i>Castor fiber</i>	<i>Capreolus capreolus</i> , <i>C.</i>
<i>Felis lynx</i>	<i>pygargus</i>
<i>Lepus timidus</i>	<i>Alces alces</i>

together with Anseriformes and Tetraonidae (*Tetrao urogallus* L. and *Tetrao tetrix* L.), Pisces, Pinnipedia, and Cetacea, could provide the subsistence for Neolithic and later tribes over vast territories of northern Asia.

CAUSES OF EXTINCTION

In reviewing changes within the megafauna, we found that the nature and cause of its disappearance were considerably more complicated than we formerly believed. A major point is that different reasons apply to different territories, and extinction cannot be explained by anthropogenic influence alone.

Primitive man played, as a rule, an auxiliary or complementary role in the destruction and change of the complex of large animals in the Pleistocene. Man's influence upon the mortality of mammoth, horse, bison, and saiga in the Russian Plain was far greater than it was over vast territories of Siberia. In the Pleistocene, in the north of Yakuti an influence of primitive man upon animals has yet to be proved. The accumulations of mammoth bones and carcasses of mammoth, rhinoceros, and bison found in frozen ground in Indigirka, Kolyma, and Novosibirsk islands bear no trace of hunting or activity of primitive man. Here large herbivorous animals perished and became extinct because of climatic and geomorphic changes, especially changes in the regime of winter snow and increase in depth of snow cover.

TABLE 2. *The Animals hunted by man in the Paleolithic, Neolithic, and Bronze Age in the Soviet Union*

P = Paleolithic, N = Neolithic and the beginning of the Bronze Age. For the Neolithic and later cultures the author has used his own unpublished data and those of Zalkin (1956, 1960, 1962) and Bibikova (1953). †, Species entirely extinct; †_p, species which became extinct in a given area, or species partially surviving or domesticated.

Species	Russian plain	Crimea	Caucasus	Urals and western Siberia	Kazakhstan and Altai	Middle Asia	East Siberia	Ussuriland
	Primates							
† _p <i>Macaca</i> sp.; macaque			P					
Carnivora								
<i>Canis lupus</i> Linnaeus; gray wolf	PN	PN	PN	PN	PN	PN	PN	PN
<i>Canis</i> sp.	N	N	N					
<i>Cuon</i> sp.; red dog			P				N	
<i>Vulpes vulpes</i> L.; red fox	PN	PN	PN	PN	PN	PN	PN	PN
<i>Vulpes corsac</i> L.; corsac fox	PN	PN	P		N		N	
<i>Vulpes lagopus</i> L.; arctic fox	PN	P		PN			P	
<i>Nyctereutes procyonoides</i> Schrenck; raccoon-dog								N
<i>Ursus arctos</i> L.; big brown bear	PN	PN	PN	PN	PN	PN		PN
† <i>Ursus spelaeus</i> Rosenmüller; cave bear	PN	P	PN	P				
<i>Selenarctos tibetanus</i> G. Cuvier; black bear								N
† <i>Crocota spelaea</i> Goldfuss; cave hyena	P	P	P	P	P	P	P	P
† <i>Leo spelaea</i> Goldfuss; cave lion	P	P	P	P		P	P	P
† _p <i>Leo leo</i> L.; lion	N		N?					
<i>Uncia uncia</i> Schreber; snow leopard						P		
<i>Panthera pardus</i> L.; leopard	N	N	PN			PN		PN
<i>Panthera tigris</i> L.; tiger			N?			N?	N?	N
<i>Felis silvestris</i> Schreber; wild cat	N	PN	PN					
<i>Felis libyca</i> Forster; spotted cat	PN	P				PN		
<i>Felix lynx</i> L.; lynx	PN	P	PN	N			N	
<i>Meles meles</i> L.; badger	PN	PN	PN	N				PN
<i>Gulo gulo</i> L.; wolverine	PN	P	P	PN			P	P
<i>Martes martes</i> L.; pine marten	N		P	N				
<i>Martes foina</i> Erxleben; stone marten		PN	PN			P		
<i>Martes zibellina</i> L.; sable				PN			PN	N
<i>Mustela eversmanni</i> Lesson; polecat	PN	PN	P	P				

TABLE 2.—continued

<i>Species</i>	Russian plain	Crimea	Caucasus	Urals and western Siberia	Kazakhstan and Altai	Middle Asia	East Siberia	Ussuriland
<i>Mustela putorius</i> L.; European polecat	P							
<i>Lutra lutra</i> L.; common otter	P		PN	PN				
Pinnipedia								
† _p <i>Phoca groenlandica</i> Erxleben; harp seal (on Baltic Sea)	N							
<i>Phoca vitulina</i> L., common seal	N							
<i>Phoca caspica</i> Gmelin; Caspian seal			N			N		
Cetacea								
<i>Tursiops truncatus</i> Montague; bottlenosed dolphin	N							
<i>Delphinus delphis</i> L.; common dolphin	N		N					
Proboscidae								
† <i>Mammuthus primigenius</i> Blumenbach; mammoth	P	P	P	P	P		P	P
Lagomorpha								
<i>Lepus europaeus</i> Pallas; European hare	P	PN	PN					
<i>Lepus timidus</i> L.; blue hare	N			N			PN	
† <i>Lepus tanaiticus</i> Gureev; Tanais hare	P	P		P				
<i>Lepus tolai</i> Pallas; Tolai hare						PN		
<i>Lepus</i> sp.							P	N
<i>Ochotona pusilla</i> Pallas; steppe pika	PN	PN		PN				
Rodentia								
<i>Hystrix leucura</i> Syxes; Indian porcupine			PN			PN		
<i>Castor fiber</i> L.; beaver	PN	PN	PN	PN				
<i>Marmota bobac</i> Müller; Bobak marmot	PN	PN	PN	PN	PN			
<i>Marmota</i> sp.							PN	
<i>Citellus rufescens</i> Keyserling et Blasius; red-cheeked souslik	P	P						
<i>Citellus pygmaeus</i> Pallas; little souslik	P	P	N					
Perissodactyla								
† <i>Dicerorhinus tichorhinus</i> Fischer; woolly rhinoceros	P	P	P	P	P		P	

TABLE 2.—continued

Species	Russian plain	Crimea	Caucasus	Urals and western Siberia	Kazakhstan and Altai	Middle Asia	East Siberia	Ussuriland
† <i>Rhinoceros</i> sp.			P					P
† _p <i>Equus caballus</i> (<i>fossilis</i>) L; tarpan	PN	P	P	P	PN	PN	P	P
† <i>Equus hydruntinus</i> Regalia; Pleistocene ass	P	P	P			P		
<i>Equus hemionus</i> Pallas; wild ass	N	N	N		PN	N	PN	
Artiodactyla								
<i>Sus scrofa</i> L.; wild boar	PN	PN	PN			P		PN
† _p <i>Camelus knoblochi</i> Poljakov; wild camel				N	P	P		
<i>Moschus moschiferus</i> L.; musk deer							N	PN
† <i>Megaceros euryceros</i> Aldrovandi; great-horn deer	P	P	P					
<i>Cervus elaphus</i> L. (<i>s. lato</i>); <i>Rangifer tarandus</i> L.; reindeer	PN	PN	PN	P	P	PN	PN	PN
<i>Cervus nippon</i> Temminck; Sika deer	P	P		PN			PN	
<i>Capreolus capreolus</i> L.; roe	PN	PN	PN					N PN
<i>Capreolus pygargus</i> Pallas; Siberian roe	PN			PN	PN	PN	PN	N PN
<i>Alces alces</i> L.; moose	PN		PN	PN			PN	PN
<i>Saiga tatarica</i> L.; saiga	P	P	P	P	N		P	
<i>Rupicapra rupicapra</i> Gray; chamois			PN					
<i>Capra caucasica</i> Güldenschtaedt; Caucasian goat			PN					
<i>Capra sibirica</i> Pallas; Siberian goat						PN	PN	
† <i>Capra</i> sp.	P	P						
<i>Ovis orientalis</i> Gmelin; Asiatic mouflon	P	P	PN			P		
<i>Ovis ammon</i> L.; Argali			P		PN		P	
† _p <i>Ovis cf. gmelini</i> Blyth; Gmelini mouflon			PN					
† <i>Ovis</i> sp.	P	P	PN					
† _p <i>Ovibos moschatus</i> Zimmerman; musk-ox	P			P			N	
† _p <i>Bison priscus</i> Bojanus (<i>s. lato</i>); bison	PN	P	PN	P	P	P	PN	P
† _p <i>Bos primigenius</i> Bojanus; European tur	PN		PN			PN		
† <i>Spirocerus kjachtensis</i> Pavlova; Kijachta antelope					P		P	
† _p <i>Poephagus baikalensis</i> Vereshchagin; wild yak					P		P	

Radiocarbon analysis of bone remains and charcoal in the Upper Paleolithic camps of the Russian Plain has shown that the latest Paleolithic camps with bones of mammoth are 9,000–14,000 years old.

Meanwhile, the latest remains of mammoth from the Arctic zone (Taimir peninsula) are also dated as 11,500 years old. Most carcasses and soft tissues of mammoth found in the frozen ground (Sanga-juriakh, Berezovka, Mokhovaja, the delta of the Lena River, and the Verchnaja Gyda) are dated now as 29,000 to 44,000 years old (see Garutt, 1965). Hence it follows that, in the Arctic, mammoth died and were preserved without the intervention of man, not only on the boundary of the Pleistocene and the Holocene but also within the whole late-Pleistocene (Würm).

Large, active, carrion-feeding carnivores (cave lions and hyenas) disappeared after the extinction of herbivores or somewhat earlier. It is more difficult to explain the extinction of cave bear. According to our observations, in the northern Urals the populations of these animals became extinct owing to changes in the flood regime: in early spring many animals were drowned in caves by rivers swollen with thawed snow. The predatory and competitive roles of primitive hunters in the extinction of this animal were also very significant.

The descriptions of layers containing bones, skeletons, and carcasses of mammoth, rhinoceros, bison, and horse in the basins of the Indigirka, Vilui, Jana, and Kolyma rivers suggest that the animals died in winter, generally in great numbers and thus catastrophically.

The corpses of herbivores were swept away with the floods into depressions. In summer these carcasses formed in boggy areas the so-called "mammoth horizon," a thick layer consisting of bones, skulls, tusks, peat, and tree trunks interlocked by permafrost. Such a horizon is sometimes exposed by river erosion for a distance of many kilometers and is characterized by a putrid smell. The detailed study of such bone accumulations could confirm or reject the conclusions on the nature of mortality of Pleistocene animals (mammoth and bison in particular) in northeastern Siberia.

The great importance of snow cover in the life of mammals and birds was proved by investigations undertaken by Formozov (1962) and Nasimovich (1955). Not low temperatures alone but cold weather accompanied by snow and ice-encrusted ground cause mass hunger and epizooty of wild and domestic ungulates in steppes of Kazakhstan and deserts of Central Asia today (Sludsky, 1963).

Decisive in the life of small and large mammals, according to Formozov (1962), is the presence or absence of ice crust. Compact crusts are formed when changeable winter weather prevails, with

alternating snowfalls, thaws, and freezes. The ice excludes air from small rodents, cuts the feet of ungulates, and deprives horses, musk-oxen and reindeer of their food. Thus climatic changes, in particular winter thaws and winds without a considerable increase of snowfall, could have a fatal significance for many Pleistocene animals.

According to investigations of Gussev (1956), who described the Quaternary deposits of northwestern Siberia, the accidental mortality and preservation of carcasses of mammoth and rhinoceros might take place only in "baidzherakh" terrain, which has layers of fossil ice eroded deeply at places by summer streams. The beds of such glacial streams, covered from above with a crust of ice and with a thin layer of silt, were on occasion insidious traps for heavy animals. Moreover, beyond all question these rare ideal instances can be related to the "mammoth level." General geologic sections (Gussev, 1956) show that the beds of silty streams eroded into the continental ice were formed at the same level as layers of "bone-bearing or lake bog deposits" (Fig. 15).

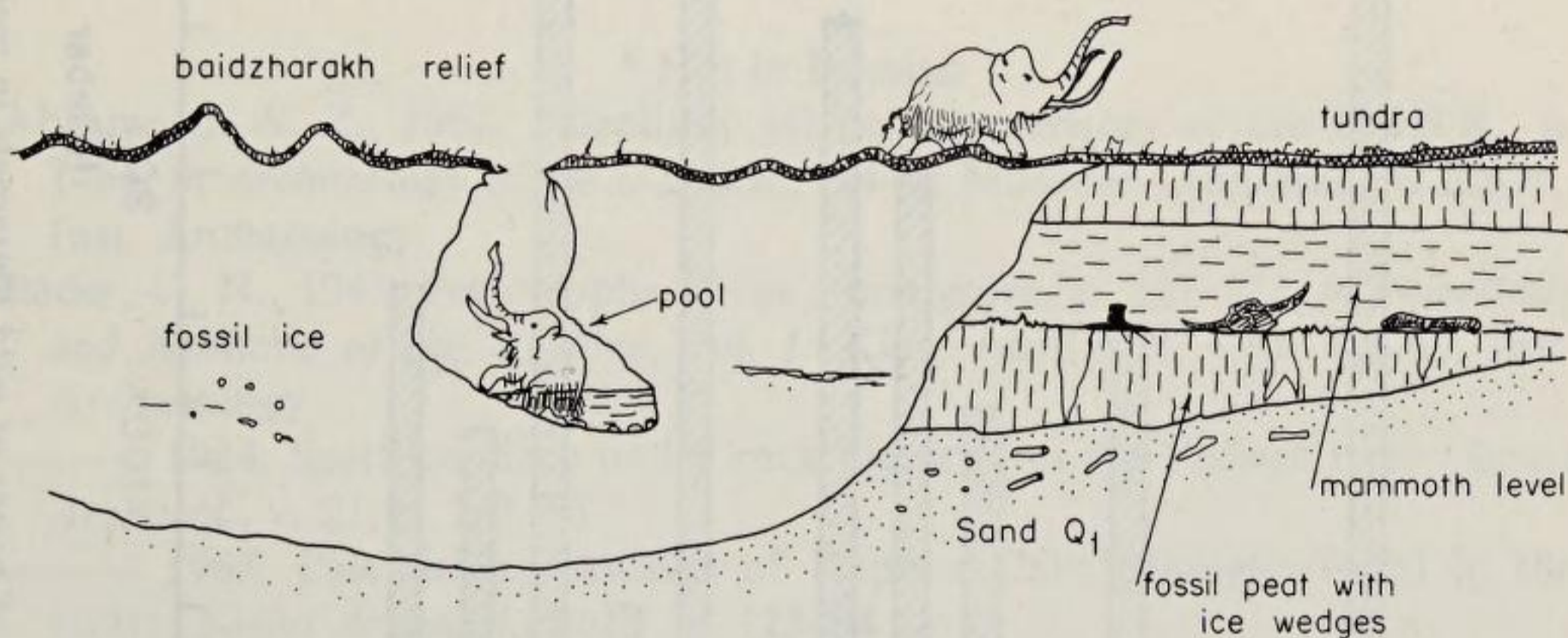


FIG. 15. Death and preservation of the mammoth in the secondary excavation of fossil ice.

Apart from the snow factor and the development of vast spring floods, the development of dense, dark coniferous forests in post-glacial time deprived ungulate animals of winter and spring food. In northeastern Siberia the marine transgression could have exerted a fatal influence.

Instead of east-European and Siberian plains, vast areas of which were suitable in the Pleistocene for supporting steppe populations of horse, bison, and saiga, in the Holocene there remained only belts of forest steppe, steppe, and semidesert stretching to the south from the taiga zone. However, it was just here (from the Carpathians to Manchuria) that herd ungulates began to feel the pressure of mounted tribes

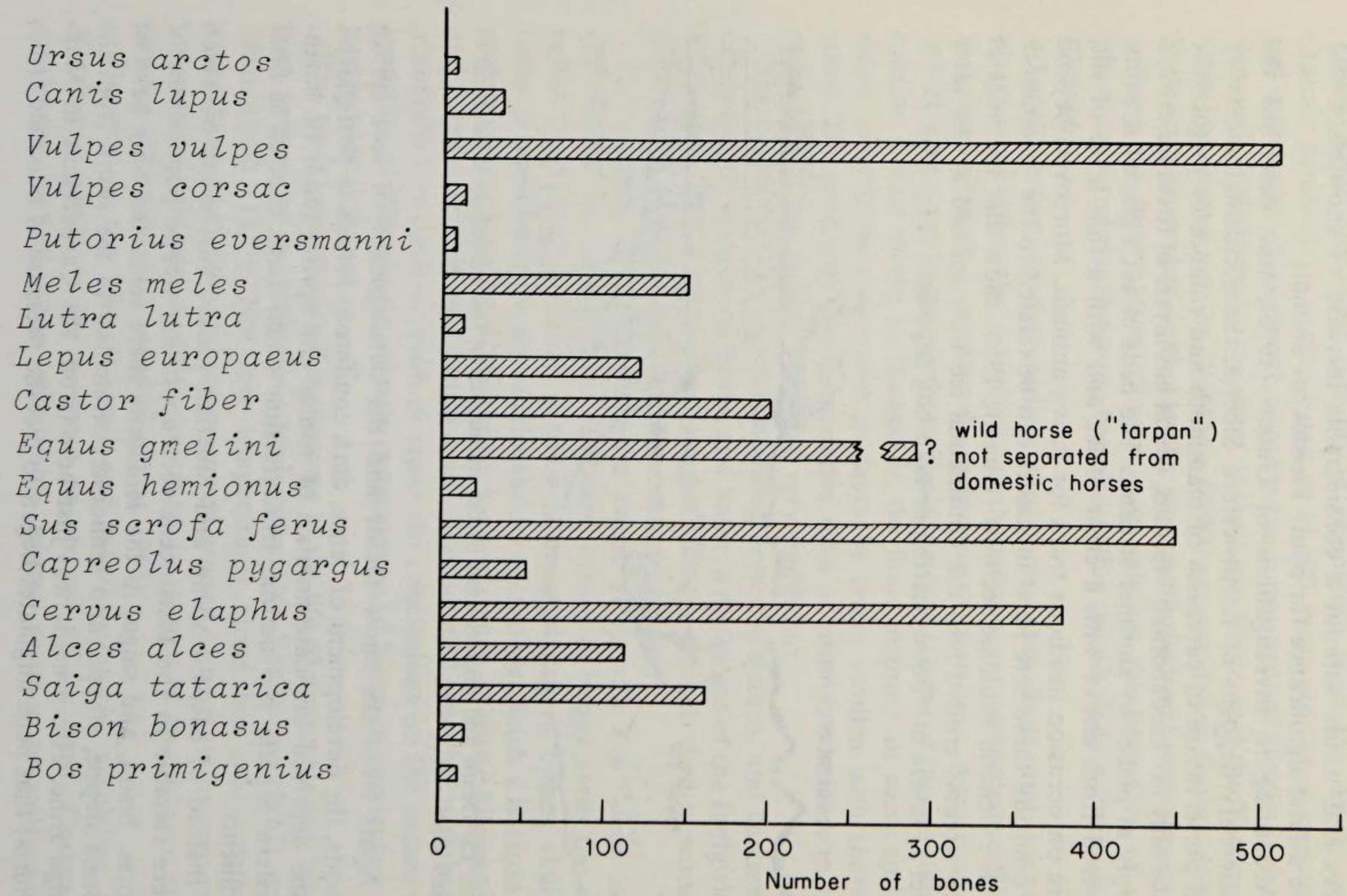


FIG. 16. Specific composition and the number of bones of wild mammals in medieval levels of Khazar fortress "Belaja vezha" (Sarkel) on the Don River; in the steppe zone.

of steppe nomads. Within the Holocene this pressure gradually increased, and at the time of the great Hun and Tartar–Mongolian campaigns, it apparently reached its culmination. Some historical data are now available (Kirikov, 1959) on the hunting of nomadic tribes in the Middle Ages (Fig. 16).

It is to be noted that, after great but short-term migration of nomads, the populations of large animals in steppe and forest–steppe did not disappear but relatively quickly returned to their former numbers. In the southern part of eastern Europe the abundance of steppe and forest animals was maintained throughout the Middle Ages.

Only the extraordinary increase of the human population, the development of cattle-breeding, and cultivation of the steppes in the nineteenth century brought the destruction of the Holocene assemblage of large animals in the Russian steppes.

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