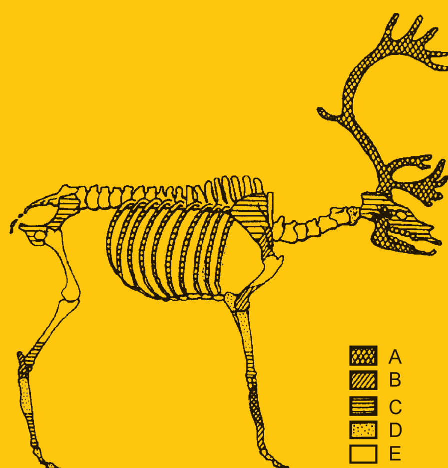
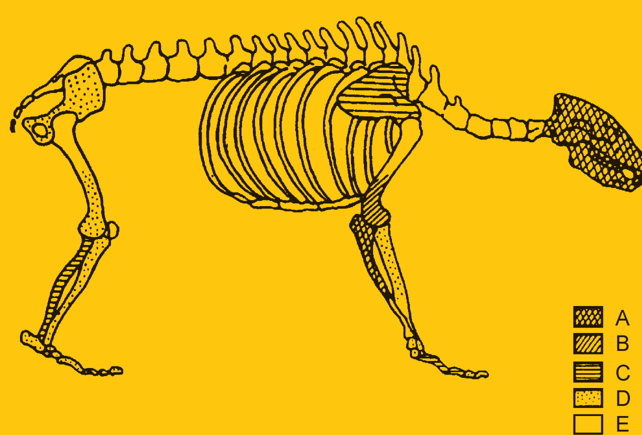
# The Zhokhov Island Site and Ancient Habitation in the Arctic




Vladimir V. Pitul'ko

Preface by
William W. Fitzhugh

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# THE ZHOKHOV ISLAND SITE AND ANCIENT HABITATION IN THE ARCTIC

## A Mesolithic Wet Site in the Arctic Ocean

**by**

**Vladimir V. Pitul'ko**

**Translated by**

**Vladimir V. Pitul'ko**

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Department of Archaeology
Simon Fraser University
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# PREFACE

**William W. Fitzhugh**
Arctic Studies Center, Smithsonian Institution

Every few decades a revelation about the ancient environment, the appearance of a remarkable artifact, a series of surprising radiocarbon dates, or the discovery of an unusual archaeological site in an unanticipated geographical location can be seen, in retrospect, as a transformative event. Such is the case with the discovery and first two years of excavation of a Mesolithic site on Zhokhov Island. Suffice to say, because of its remote High Arctic location (76° North), its remarkable preservation, and its 7800-8000 B.P. date, Zhokhov can be considered as the most important archaeological site investigated in the Arctic region in the past two decades.

The account presented here is a translation of the original Russian monograph published by Vladimir V. Pitul'ko in 1998. In addition to providing a full account of the Zhokhov site, its geographical and environmental setting, the finds recovered, and its chronology and cultural relationships, this book is also the most comprehensive English language survey of Late Pleistocene and Holocene archaeology and paleoenvironments of northern Eurasia. For this reason *The Zhokov Island Site and Ancient Habitation in the Arctic* is much more than a report on an important Arctic site; it provides readers with a window into the Russian scholarly literature dealing with nearly half of the globe's Arctic lands, places which have been inaccessible physically and intellectually to Westerners for most of the 20th century.

The archaeology of the Russian Arctic is less well-known than most other regions of the North, and Zhokhov illustrates the difficulties researchers have encountered in trying to assemble the early history of the Russian Arctic. Its remote location on an 11 km long island in the De Long chain of the New Siberian Islands at the northeastern edge of the Laptev Sea is 425 km from the nearest Siberian coast and 300 km southwest of the continental shelf. Surrounded by a sea floor that is only 50 m deep, during the period when it was occupied Zhokhov would either have been a coastal cape on the New Siberian Peninsula or a newly-created island off a southward-receding Siberian shoreline. The great abundance of drift-wood which is the most salient characteristic of Zhokhov's physical remains suggests that a mouth of the ancient Lena River delta was nearby. In part Zhokhov is important because all of the other archaeological sites that would have been present on the huge expanse of Russia's continental shelf, have been inundated or washed away by rising sea levels.

Today Zhokov is less accessible than it was when Mesolithic caribou and polar bear hunters constructed a cluster of drift-wood houses here and lived for some years or possibly sporadically over several decades. Zhokhov owes its discovery to a Soviet weather and military station that was established on the island in 1955 and existed until 1993. Curious about the volumes of wood emerging from a mound far from the current shoreline, workers sent samples of human-worked wood that reached Leonid Khlobystin in St. Peterburg and were radiocarbon-dated. Expecting

Iron Age dates, researchers were amazed at the prospect of a frozen early Holocene settlement in such an extreme location and organized expeditions in 1989 and 1990. The first publication was issued by Pitul'ko in Russia in 1989, and two years later Pitul'ko and V. M. Makeyev announced the finds to the world in an article in *Nature* in 1991. Since publication of the Russian version of this book, Pitul'ko and a group of natural science colleagues have conducted intensive investigations at Zhokhov for nearly a decade, excavating much of the frozen village site, analyzing finds ranging from artworks to dog feces, and exploring its sediments for clues about climate and paleoenvironment. This volume sets the foundation for that forthcoming more detailed study.

Half of this book reports the Zhokhov site and the finds recovered there. A large series of radiocarbon dates bracket the site's age between 7800–8000 B.P. (8408–8175 B.P. calibrated). Pollen, macrofossils, and other data indicate that 1,000 years earlier, the Yakutian lowlands had experienced its peak Holocene warming, when the forest limit reached the location of the modern coastline and conditions were slightly warmer than today. Even though conditions were somewhat cooler—perhaps more like today's conditions—during Zhokhov's occupation, wild reindeer (caribou) migrated between the forest edge to the south and the Arctic Ocean coast, then around the latitude of Zhokhov. Moose were plentiful in the lowland forests, and seals, walrus, and polar bears inhabited the coastal waters. Birds, fish, and small mammals were also widely available, at least seasonally. Zhokov's fauna—carefully analyzed here—are diverse, but are dominated by reindeer and polar bear. This is a completely unique economic complex, not seen in any other archaeological or ethnographic examples, and it attests to an adaptation focused on intercepting the northward seasonal migration of reindeer during the summer and hunting polar bears, probably by intercepting them, with the aid of dogs, in their dens in spring. The site gave little support for a maritime adaptation, either in settlement pattern, faunal remains, or technology. The latter demonstrated a Sumnagin Mesolithic assemblage that is dominated by a distinctive core and blade technique directed at producing microblade insets for antler knives and spear points, and ground stone axes for wood-working and butchering. Stone scrapers and bifaces are absent, and domestic implements included wood and bone bowls and troughs. Use of mammoth bone was widespread, though evidence for mammoth hunting was absent, suggesting scavenging as the means of supply. A wooden sled runner is the earliest example of this technology in the Arctic; these sleds were probably pulled by humans rather than dogs because no trace buckles were found.

Despite excellent preservation of lithic and organic artifacts due to the site's pervasive permafrost (only the upper 10 cm thaws in a given summer), cryogenic processes had destroyed all traces of the site's original habitation structures. Logs used to frame dwellings had been splintered into shreds by solifluxion and other cryogenic processes; living floors and middens were churned together with splintered logs and artifact remains, and these twisted deposits ended up being cross-cut by ice lenses, ice wedges, and ground ice derived from the summer snow-melt and the seasonal creek that runs past the site. As a result the actual settlement plan, house sizes and shapes, and other features could not be ascertained. Nevertheless, in appreciating such a rich slice of life at the top of the world at 8000 BP one has to accept some imperfection.

This book also illuminates a world beyond Zhokhov by establishing the site's environmental context, its likely climatic scenario, and Zhokhov's place in the culture historical framework for northern Russia and northeastern Siberia. Although this text is dated to the early 1990s the discussion of the typology and periodization used for the Russian north helps us realize how rapidly the field is changing and how closely Soviet/Russian archaeologists worked with their environmental colleague in the discovery and interpretation of archaeological finds and cultures. Piltul'ko's discussion of the Zhokhov "Mesolithic" helps clarify divisions in the Russian ranks about this use of this stage term. His wide-ranging comparisons, from Scandinavia to Alaska and Greenland, adds to the international discussion about circumpolar culture, illustrates the importance of the adaptation to migratory reindeer, and shows how early Holocene hunters' use of polar bear demonstrated a step towards developing a more stable economy that caribou alone could offer.

As in most things archaeological, Zhokhov owes its existence to a series of lucky breaks: choice of a site location far from the 8000 BP shore; geomorphic and cryogenic processes that preserved the remains despite the flooding of hundreds of kilometers of Russia's Continental shelf; curious station workers who thought to send samples to scientists; researchers who bothered to date a piece of wood that seemed likely of recent origin; and perhaps we even have to thank Soviet military policy for maintaining an extremely forward Cold War base (if Perestroika had been five years earlier, the Zhokhov base would have been abandoned before knowledge of the site reached archaeologists). Zhokhov deserves a special place in the history of Arctic archaeology along with Ipiutak and a few other landmarks of culture history. As we shall see in future publications documenting more recent research, Zhokhov is a bright beacon in the still-dimly lit archive of Northeast Siberian culture history.

# INTRODUCTION

Everyone who has traveled at least once through the Arctic regions (whether by plane, helicopter, ship, etc.) and seen boundless tundra that is yellow-green in summer and white in winter with black spots of rocks; icy ocean with dark water in leads; naturally asks himself, "Is it possible to survive here?" It is true that even now the Arctic remains a severe, inhospitable region, never forgiving disrespect. Even at the end of the $20^{th}$ century when mankind has reached a technological power that sometimes seems to be somewhat more than enough, the Arctic remains the same sparsely populated area as it was originally. It is also true that there are some rare "spots of civilization" that look like black dots on the white snow cover.

At the same time, there are many aboriginal people who have lived in the Arctic for a very long time—long enough to adapt themselves and their culture to survive under those rigorous conditions. But how long? When were the Arctic regions peopled for the first time? The archaeological data provide an opportunity to answer these questions more or less objectively, based on the available data collected by both archaeologists and natural scientists.

Ancient man and the natural environment, human material culture and adaptive capabilities, as they can be understood through the latter—these fields of research are a traditional way of studying Stone Age archaeology. But they become most important when applied to problems of the ancient history of the Arctic region, where well-expressed environmental variability (both spatial and chronological) brought about a variety of subsistence and settlement patterns from the very beginning. The starting point for the peopling of the region is not clearly defined, and in all probability cannot be, since nature provided unequal opportunity for development in different territories. At the same time, it is beyond any doubt that the initial peopling of the Arctic goes back to the Late Quaternary times when the American continent was settled.

However, the Arctic is not something uniform from west to east. It includes some areas that are rather different from each other, though the differences are leveled by the general environmental features characteristic of Polar Regions. First of all, what is the Arctic? Igor Krupnik, opening his excellent "Arctic Ethnoecology," has compared the most popular views, concentrating on the following: (1) the Arctic (or Circumpolar Area) is limited by the Arctic Circle at 66°33' N (the most traditional); (2) it is limited by the northern boundary of the distribution of tree vegetation; (3) the boundary of the Arctic region can be marked by the spatial position of the July isotherm of +10°C, which is generally located a little north of the northern tree line but can be considered more or less close to it. From the purely geographical point of view, the Arctic includes the Arctic proper, or High Arctic (Arctic deserts and semi-deserts) and the Subarctic areas (tundras and sparse north woods). At the same time, it is quite obvious that all these criteria except the first are rather unstable from the historical point of view, inasmuch as data on Late Quaternary natural dynamics in the Arctic amassed to the present demonstrate that the Arctic environment did not remain stable and constant. There occurred climatic alterations and latitudinal shifting of the vegetation belts, i.e., reordering of ecosystems that strongly affect human activity and culture. Natural conditions have been more or less stable over the past 3,000–4,000 years, though some regional climatic fluctuations are known during this period caused a collapse in some localities or substantially influenced local cultural evolution (Pitul'ko 1990:74–79; Pitul'ko and Shumkin 1993:39–46). It is worth noting that the northernmost sites in Greenland, situated at 82°N, show human penetration into Arctic-proper areas and are dated approximately to the beginning of that period.

Nevertheless, criteria such as the northern tree line or the 10-degree July isotherm are helpful if the cultural evolution under consideration covers a period of constant or more or less stable natural conditions. Consequently, discussing the above-mentioned positions, Krupnik (1989) is inclined to support the latter, keeping in mind the evident stability of the northern tree line during the past 200–300 years; this is important from both the ecological and the ethnographic views. Let me also note that the severe nature of the Arctic directly affect the formation of Arctic indigenous cultures, whose bearers were integrated into the sphere of world civilization relatively late. Consequently the conservative type of aboriginal hunting culture exhibits features suggested to be a background for comparison with the culture of the Late Upper–Upper Palaeolithic, though the correctness of such analogies is disputable.

Considering both the above-mentioned reasons and the available data coming from the territories under discussion, it would be correct to put the "geographic limit" of the study at the latitude of the Arctic Circle, which is the most permanent natural boundary of the Arctic. Of course, it is acceptable only in as much as it is possible to generally apply a "ruler" to human activity. Thus, it would be illogical to take into account materials from the Yakut Arctic area that leave out finds from the Chukchi Peninsula, or from other territories south of the Arctic Circle. The Arctic cultures indisputably stemmed from the southern roots. Materials coming southward will be discussed if necessary.

When using the term "Arctic" I mean more often the Eurasian one and try to present in the last chapter a kind of transcontinental correlation of the aboriginal survival strategies as I understand them from the archaeological finds. The artifacts coming from the eastern Arctic, where the most complete historical information of the long chronological scale (at least from the Pleistocene–Holocene boundary up to ethnographic contemporaneity) is available, will be primary in later discussion, and the question of early migrations to the Arctic will receive special attention.

Obviously, there is no necessity to thoroughly describe the present natural environment of the Arctic region. This is a good subject for another study and, moreover, will not help evaluate the ancient steps of cultural evolution in the region. I want only to note that the Arctic biota is not the same from west to east. Together with the predominating territories of scanty vegetation, some refuges make up a part of the Arctic natural phenomenon—such as Wrangel Island where about 400 species of higher vegetation are counted—more than in the entire Canadian Arctic Archipelago (Petrovsky 1989). At the same time it needs to be stressed that, along with the still-existing latitudinal zonality becoming more intense from north to south, there is a distinct meridianal trend that was probably of greater importance in former times. Four main provinces need to be pointed out: Atlantic and Pacific, Siberian and Canadian. For the first pair, owing to the cyclonic type of atmospheric circulation, the land glaciation and the climate of oceanic type are very characteristic. The latter is especially perceptible in the Atlantic area, where winters in some locations are anomalously warm for the Arctic region. Siberian and Canadian areas occupying the northern borderlands (including the seas and islands) of Siberia and Canada have a corresponding climate of continental type and remain mainly under a very strong anti-cyclonic atmospheric circulation. The latter is formed above Northeast Siberia, the Canadian Northwest Territories, and the Pacific area of the Arctic Ocean (The Arctic and the South Oceans 1985:126, 127).

The peculiarities of the atmospheric circulation strongly affected natural evolution in the Arctic during the Late Pleistocene and Holocene periods. That is why the latter occupy a significant place in further discussion. From the archaeological point of view, the book is occupied primarily with the materials from the unique Zhokhov island archaeological site that was excavated in 1989 and 1990.

# CHAPTER I

## From Birth to Collapse: On the History of Archaeological Studies in the Russian Arctic

It is astonishing that archaeological studies in the Arctic have a history of more than two hundred years. However, during most of this period the materials were collected sporadically, and the rare explorations were amateur in character. Sporadic professional expeditions were often focused on surveying for relics of a special character.

The excavations at the Eskimo site on Cape Bolshoi Baranov, east of the Kolyma River mouth, were carried out by Captain G.A. Sarychev (who was the leader of a special research team on the Billings expedition, undertaken in 1785–1793) on June 22 in 1787, and they are considered the starting point of Arctic archaeology (Sarychev 1802:95, 96). It must be stressed that it was not an occasional excavation and collection of strange objects but real excavations undertaken with the deliberate intention of getting information about the former inhabitants of abandoned ruins of semisubterranean houses seen near Cape Bolshoi Baranov. For Russia this fact is doubly remarkable, being the starting point of Russian archaeology in general (Khlobystin 1991).

Inasmuch as the present study deals with a vast territory, it seems logical to give a historical sketch of the archaeological studies in sequence with the main natural areas that make up the region under consideration: Northeast Europe (including the Kola Peninsula and the Malozemelskaya and Bolshezemelskaya Tundras), Northwest Siberia, the Taimyr Peninsula, and Northeast Asia.

Investigations in Transpolar areas of Northeast Europe, where the first notes on the archaeological sites are dated to 1592—from the records of the Russian ambassadors who visited the Kola Peninsula for negotiations on the disputed position of the Russian-Norwegian frontier and described stone features in Varanger Fjord and near Kola village)—began only in the late 19th century, though some archaeological finds were reported from time to time (Schmidt 1930; Gurina 1951).

Polar areas were gradually included in the sphere of scientific archaeology; the first expeditions to those territories were preceded by surveys of the southern Karelia, Vologda, and Vyatka Regions—carried out by N.F. Butenyev, I. Lerkh and I.S. Polyakov. The White Sea coast was also surveyed in the archaeological custom of that time by N.K. Zenger, assigned by the Committee of the Moscow Astronomy Exhibition. Zenger's expedition produced a lot of materials collected from sites along the White Sea coast (so-called Zimny Bereg ["Winter Coast"]) or from the indigenous population (Zenger 1877). A.I. Kelsiyev also participated the expedition that visited the Kola Peninsula. Some years before, in 1874, A.I. Schtukenberg, doing geological reconnaissance of the Timan Tundra (a locality surrounding Timan Ridge), discovered the first Stone Age site in the European Arctic (Schtukenberg 1875:XI). Data on relics coming out of the European North were included in the famous monograph Russian Archaeology by Count A.S. Uvarov (1881), who summarized all the archaeological facts known that time.

The collection of archaeological materials moved forward in the 1890s. Thus K.P. Reva was the first to investigate a locality on the White Sea coast—Letny Bereg ["Summer Coast"], and later the Tersky Bereg of the Kola Peninsula (Reva 1898). Also in the early 1890s, a collection of stone tools found in the Timan Tundra were presented to the Imperial Archaeological Committee by F.M. Istomin (Khlobystin 1973:54).

Some episodes of archaeological activity took place at the beginning of the twentieth century. In 1905 and 1907 naturalist A.V. Zhuravsky discovered sites providing rich collections in the Bolshezemelskaya Tundra (in the Kolva River valley). An abundance of stone tools were collected by geographer N.A. Kulik in the Bolshezemelskaya Tundra (near the Arctic Circle on the Adzva and Bolshaya Rogovaya Rivers) during expeditions of 1909 and 1910. His finds were reported in some articles (Zhuravsky 1909; Kulik 1914, 1915). Surprisingly, they were professionally recognized only much later, in 1950s, when N.N. Gurina (1951) and M.E. Foss (1952) reviewed the archaeological data from the Russian North. However, it should be mentioned that both Kulik and Zhuravsky had never overestimated either the significance or antiquity of the finds. For instance, A.V. Zhuravsky, commenting on the materials discovered, wrote that "the Stone Age on our extreme north ended in the epoch when Europe began true history and advanced civilization had moved far from a stone knife" (Zhuravsky 1909:207–209).

Concurrently, about the turn of the century, the first archaeological explorations were carried out in the Arctic islands, which still remain poorly explored. There were the excavations of the ruins of the Russian Pomor people, who visited Spitsbergen (Svalbard) in the 16th and 17th centuries (Starkov 1991:18).

The western Siberian North and the Taimyr Peninsula were also archaeological blank spots up to the second half of the 20th century. During all that time only the collection by geologist Novitsky, who gathered few artifacts at the Ob' River mouth, could be mentioned for the western Siberian North (Chernetsov 1953). Some episodes of archaeological survey took place there from 1920 to 1930 (Chernetsov 1935). As far as the Taimyr Peninsula is concerned, the first archaeological investigations were begun in the late 1960s by Leonid P. Khlobystin, who was my teacher and one of the most brilliant archaeologists ever to study the Arctic.

Studies in the archaeology of Northeast Asia—though the first excavations in the history of all Arctic archaeology were undertaken there—were sporadic. About 100 years later, in 1878, Alfred Eirik Nordenskjold carried out similar excavations during his famous voyage along the Arctic coast of Eurasia on the yacht Vega. Some test pits were dug in ancient semisubterranean Eskimo dwellings at Cape Schmidt (Nordenskjold 1936). Approximately the same time N.I. Popov published the finds of the Russian Church missionary Aleksey Argentov, who traveled on the lower reaches of the Kolyma River for several years (Argentov 1879), and the "axe of cryptocristalline rock" presented to the East Siberian Department of the Russian Geographic Society by Baron G.A. Maidel, a leader of the Chuckchi Expedition sponsored by the Russian Academy (Popov 1878:60). Unfortunately, these finds were not put on the map, but it is obvious that few sites were discovered in intracontinental areas during this period because the numerous Eskimo sites known on the Northeast Asian coast were much more attractive to both amateur and professional archaeologists. These works also were rare, and we can mention only collections by Edward Nelson from the Vankarem Eskimo settlement (Nelson 1899:265–266), items from the Naukan Eskimo settlement gathered by Knuth Rasmussen (Dikov 1979:12), and artifacts presented to the Ethnographic Department of the Russian Museum in St. Petersburg by D.E. Bettak and N.P. Borisov in 1910. The latter artifacts were published later by A.V. Machinsky (1941). Few finds, discovered somewhere in the interior of the Anadyr Region about 1910, were presented to the Regional Museum in Khabarovsk and described later by Vladimir Arsen'yev, the famous Russian explorer of the Far East (1948:118–123). These finds were of great interest because broken and burned bones of mammoth and other animals comprising a Late Pleistocene faunal assemblage were collected there. Unfortunately that location was not known exactly.

Some archaeological work was carried out at that time in Yakutia where the southernmost areas were surveyed by amateur archaeologist M.P. Ovchinnikov, who excavated Neolithic graves near Olekminsk (Ovchinnikov 1890). The first Yakutian rock art was discovered during the same period by another researcher, N.A. Vitashevsky.

The years of the First World War, the Revolutionary and Civil War period, and the period of economic collapse in Russia—when all research was stopped for a while in the Russian Arctic—is in my view the natural upper chronological limit of the stage of initial archaeological studies in the Russian Arctic covering about 120–130 years. To briefly summarize the results, I should mention that scanty materials were sporadically found and collected that covered a long period of time: from relics of "historical contemporaneity" (Russian Pomor dwelling sites on the Svalbard Archipelago and Eskimo settlements of the Chukchi Peninsula) back to some periods of the Stone Age. The significance and antiquity of the finds were interpreted guardedly (Zhuravsky 1909), considering human habitation in the Arctic as rather late. Still, the ideas that appeared to be of much importance for further progress in Arctic anthropological studies were advanced, based on the results of discoveries by numerous and successful ethnographic expeditions (Jessup should be mentioned first) as well as natural science research. Scanty archaeological materials were used in hypotheses explaining similarities observed in the material cultures of different aboriginal ethnic groups that settled in the Arctic. These distinct features, noted by many students of anthropology, pushed forward a form of the "circumpolar culture" concept first advanced by F. Graebner (1911). His ideas were popular for a long time and supported or developed by scientists such as W.G. Bogoras (1929), F. Flor (1930) and others. Though those ideas were different in details from Graebner's original concept, they were rather close and based on the idea of convergent evolution. But the latter was most thoroughly substantiated by W. Talbitzer (1924) and F. Boas (1930), and ultimately all these ideas were combined by G. Hatt in North American and Eurasian Culture Connections (1934). Later, Gutorm Jessing (1944) applied the concept of a "circumpolar culture" based on ethnographic observations to the archaeological data. The studies of his scientific predecessors, such as Boas, Bogoras, Jochelson, Talbitzer and others, were focused on a particular question of Arctic history—the Eskimo problem, including their origin, adaptations, and migrations in the American and Canadian Arctic and in Northeast Asia. In Russia a very detailed review of these works has been published by S.I. Rudenko (1947:4–28), S.A. Arutyunov and D.A. Sergeev (1969:7–26), and Yu. B. Simchenko (1969:7–10).

Undoubtedly, all of these studies comprise a classical background of current Arctic anthropology, but Gudmund Hatt was the first to make an effort to recognize different chronological levels of the Arctic cultures and the archaic components among them; thus is his indisputable distinguished contribution. Hatt's ideas were successfully elaborated by K. Birket-Smith, who applied them to Caribou Eskimo history, taking into consideration available archaeological data discovered by the Fifth Thule Expedition of Knuth Rasmussen (Birket-Smith 1929). Although the publications under consideration, as well as those thereafter, were published—from the chronological view—after the conventional end of the first (initial) period of studies in Arctic anthropology, it might be necessary to mention them now inasmuch as they were based on results obtained in the 19th or first decade of the 20th century.

The results of natural science research (geology, paleontology, paleozoology, paleobotany), undertaken during that period in both Northeast Asia and North America, were also of great importance for advancing anthropological studies concerning the problem of ancient migrations to (or through) the Arctic. That problem had been brought to the forefront because of archaeological finds of Paleolithic character discovered in North America in the 19th century. Their age and therefore the ancient migration routes to the American continent appeared to be the most crucial questions. A historiography of these problems is outside the focus of the present study, but I will comment on some of the most significant points for the discussion. It could also be noted that in Russia the best review on these questions I have ever read was published by I.P. Laricheva in Palaeoindian Cultures of the North America (1976).

First of all, it is necessary to note that evidence (both artifacts and skeletal) of the Pleistocene age remains, pointing out the considerable antiquity of human habitation on the American Continent. This was fully recognized in the early 1930s only when the results of different fields of research were summarized in The American Aborigines: Their Origin and Antiquity, edited by D. Jenness (1933). All of the questions connected directly with the problems considered in this book were discussed there, in particular the problem of Late Pleistocene human migrations across the land isthmus between the Eurasian and North American continents. A theory on the land bridge that once existed at that place was advanced about ten years before, in the 1920s. This was concluded by the Russian zoologist A. Ya. Tugarinov, who studied the zoogeography of that area and was the first to use the term "Beringia." Another Russian scientist—anthropologist W. Jochelson—who left Russia in the pre-Revolutionary period, called that territory "Hol-Arctica." The latter, based primarily on Eskimo ethnography, concluded that the Eskimos originated when that land isthmus existed near the Pleistocene-Holocene boundary.

As early as 1926 W. Jonston, trying to join together the initial human migration to the New World and the most favorable climatic epoch, suggested for the first time the possibility of migrations across the Bering Land Bridge about 20,000–15,000 BP, during the maximal stage of the Wisconsin Glaciation (Jonston 1926). Jonston's ideas were further developed by E. Antevs (1935) and later won worldwide recognition.

Therefore, in spite of the mosaic character of the data, the most important theories put into background studies carried out within later decades and up to the modern day—both in the archaeology and paleogeography of the East Arctic—were advanced by Russian and American scholars based on scanty materials obtained during the initial period of Arctic research. In this connection, it is very important to pay special attention to the opinion of Russian geologist I.D. Chersky (1891), who examined a collection of Quaternary faunal remains gathered by the expedition of Baron Edward V. Toll (1899), one of the famous Russian Polar researchers, on the New Siberian Islands. Before that time Chersky led the excavations undertaken due to construction of the Military Hospital in Irkutsk, assisted by A.L. Chekanovsky, where the contemporaneity of a mammoth fauna assemblage and man was first revealed in Siberia (Chersky 1872). That was a discovery of great importance and, keeping in mind both his own experience and the faunal composition observed, Chersky—as far back as in 1891—had advanced the hypothesis that East Siberia was populated by Paleolithic man up to the northernmost land limits, and even farther northward into the Arctic islands. Polar researcher M.M. Ermolaev, who spent some years on the islands of the New Siberian Archipelago surveying the area and leading the Climate-Geomagnetic Observatory, reached the same conclusion (Ermolaev 1932). Vladimir Arsen'ev, who examined broken burned mammoth bones from the Anadyr River Region in the 1920s, considered that possibility to be indisputable (Arsen'ev 1948).

The next period of Russian archaeological research in the Arctic covers the extremely short chronological interval from the mid-1920s to the late 1950s, when regional interdisciplinary research centers were established. Archaeological materials of different chronology, primarily relatively recent, were discovered during that time and given to some museums and institutions. Gradual accumulation of collections was a background for the episodic professional archaeological projects that appear to be a very characteristic feature of the whole period. Sometimes the projects were promoted by examples of significant research carried out on neighboring territories. Thus, brilliant research by A. Nummedal (1929) in Finmarken, where evidence of the ancient peopling of the Norwegian North was revealed, resulted in a project ordered by the Soviet State Academy for Material Culture (GAIMK) and INQA. Led by geologist B.F. Zemlyakov, the project was rather successful; twelve sites ascribed to the so-called "Arctic Paleolithic" culture were discovered and put on maps (Zemlyakov 1937, 1940). These were recognized later as sites of the Mesolithic Komsa culture, spreading throughout northern Scandinavia. Geologist G.A. Chernov, who gathered surface finds in the extreme northeastern European Trans-Polar area, had started collecting in the late 1930s. It is worth noting that though he was not a professional archaeologist, the major part of collections known from the extensive Bolshezemelskaya Tundra area and illumination of the period of human habitation in that area, from the very beginning in the Mesolithic up to the Dark Ages, are the result of Chernov's collecting. He published some articles and summarized his findings later in Atlas of Bolshezemelskaya Tundra

Archaeology (Chernov 1985). However, the artifacts found by Chernov as well as other amateur archaeologists (the most famous after Chernov is geologist A.I. Blokhin) were collected primarily from blowouts. Due to that custom assemblages are composed of the artifacts of different chronologies. Unfortunately, the collection from the Pechora site, published by N.N. Gurina in 1957, is of the same condition.

As a rule, projects carried out in other Arctic regions have given information on the most recent archaeology characterizing the latest stages of human habitation in the Arctic. Thus one should mention V.N. Chernov's expedition to the Yamal Peninsula in 1924, the results of which, together with archaeological materials excavated by V.S. Andrianov from the Ust-Polui site in Salekhard in 1935–1936, made it possible to discuss the formation of a specific pattern of maritime adaptation around the Yamal Peninsula (Chernetsov 1935; Chard 1963; Moshinskaya 1965). A series of artifacts found by D.N. Redrikov near Salekhard and R.E. Kols near the Taz River mouth (Chernetsov 1953) completes the listing of archaeological sites discovered in Northwestern Siberia from the mid-1920s to the late 1950s. Studies in Eskimo archaeology became rather popular during that period too. Two very successful projects were undertaken by the Leningrad Branch of the Institute for Material Culture History (IIMK). The first—led by S.I Rudenko who surveyed a significant part of Chukchi Peninsula coast—was supported by the Chief Department of the North Polar Route. The collection of abundant materials from Northeast Asian Eskimo sites for the first time and careful examination of them later placed Rudenko (1947) among the classics of Arctic archaeology. The second project carried out under the leadership of Aleksey P. Okladnikov—who was (and still remains) undoubtedly the most famous Russian scholar of Siberian archaeology—focused on excavations of the westernmost Eskimo dwelling site near the Kolyma River mouth, where Sarychev initiated Arctic and began archaeology. Okladnikov's excavations at Cape Bolshoi Baranov in 1946 (Okladnikov and Beregovaya 1971) remain a unique Soviet-Russian project in Eskimo archaeology because since that time no archaeologist has excavated Eskimo settlements; subsequent projects were focused primarily on excavating burial grounds.

Information on the Trans-Polar (or Arctic) Stone Age remained rather scanty during that period, and there were areas where it was completely unknown—such as Northwestern Siberia, the Taimyr Peninsula, and Yakutia, excluding Lena River valley. For exactly the same reason excavations at the Neolithic Syurakh-Ary site in Yakutia by N.B. Kyakshto (1933) need to be mentioned, as well as isolated artifacts and small assemblages collected at interior locations of the Chukotka Region by geologists (N.N. Levoshin and N.A. Grave at the Yakitikiveem River and at Chirovoe Lake; A.K. Sayapin and N.A. Nekrasov at El'gygytgyn Lake and at the Vakarevo locality of the Anadyr River Valley), and also excavations near the Kanchalan River mouth by V.V. Naryshkin, who was a Director of the Chukchi Local Museum. Okladnikov considered these materials to be of great importance, on the one hand, for further archaeological surveying of the territories and, on the other, for a preliminary consideration of local cultural evolution in the Stone Age (Okladnikov 1950, 1953; Okladnikov and Naryshkin 1955; Okladnikov and Nekrasov 1957).

Information on the ancient populating of the greatest part of the Eurasian Arctic continued to be mixed in character. Due to the investigations of A.P. Okladnikov, who led the Lena Expedition of the Institute for Material Culture History in 1940–1946 (the project was not interrupted even by the World War), the Yakutian Region was surveyed along the Lena River valley where a large number of sites were discovered and excavated. Based on these collections, Okladnikov was able to propose a preliminary regional chronology covering the period from Paleolithic times to the 17th century, when Russian sovereignty was extended to Northeast Asia and the Yakutian Region; other territories also became provinces of a unified state. In certain details Okladnikov's scheme of cultural sequences, published in a series of articles (Okladnikov 1945; 1946; 1950; 1955), is still rather important for Northeast Asian archaeology. Very few finds of Stone Age sites from the Chukchi Region were put into that scheme, extended by the author throughout Northeast Asia.

The archaeological results of Okladnikov's Lena Expedition were of great significance. Twenty-six Paleolithic sites were discovered in the Lena River valley, with the northernmost (at that time) stratified Chastinskaya site being north of the Arctic Circle at 68° north latitude. The Chastinskaya site provided the first archaeological evidence of the populating of the East Siberian Polar areas during Paleolithic times. In A.P. Okladnikov's view, two migration waves of Paleolithic mammoth hunters penetrated into the present Yakutian Region in "pre-Glacial" and "post-Glacial" periods, but the territories were completely occupied only in the Neolithic (Okladnikov 1955:70, 71). Data on the Neolithic period of that area were much firmer; the Yakutian Neolithic was supposed to be comparable to Neolithic cultures in both the Baikal and Trans-Baikal Regions; regional Neolithic cultural chronology and some variants of local cultural evolution were revealed there. From the available data, Okladnikov concluded that Yakutian Neolithic cultures were in close connection (or relationship) with the contemporaneous cultures of the Far East, the Chukchi Peninsula, and probably the North American Neolithic cultures. This allowed him to assign a special role for Yakutian Neolithic cultures in "a worldwide cultural history of the Stone Age," mediating a cultural connection "between the ancient cultures of the Old World and the New" (Okladnikov 1955:30). However, in V.A. Argunov's opinion, the lack of data brought the researcher to the erroneous conclusion of uneven cultural development in some areas of the Yakutian Region during the Neolithic—supposed by A.P. Okladnikov to have been effected in the formation of the two cultural areas. Nevertheless, Okladnikov correctly noted the characteristics of these Middle and Lower Lena Neolithic cultural areas, and the data obtained later by N.N. Dikov on Chukchi Peninsula tend to support Okladnikov's view. In my opinion, the traits of cultural evolution observed in these two Neolithic cultural areas, responding respectively to tundra and forest zones, mark different adaptations caused by different ecology (Pitul'ko 1990b).

During the late 1940s and 1950s geologists from the Institute of Arctic Geology (P.I. Glushinsky, A.P. Puminov, F.F. Iljin, V.V. Zhukov) collected the first archaeological finds in the Trans-Polar basins of the Anabar and Olenek Rivers. Some of the artifacts were probably associated with Pleistocene faunal remains (Glushinsky and Khlobystin 1966; Okladnikov and Puminov 1958; Khlobystin 1970).

The buildup of knowledge during the second period of Russian Arctic archaeological research made it possible to advance some regional generalizations. Besides Okladnikov's studies mentioned above, works by N.N. Gurina (1951) and M.E. Foss (1952) were dedicated to the Kola Peninsula Neolithic and to the Northeastern European Stone Age, respectively. At that time V.N. Chernetsov (1953, 1957) and S.I. Rudenko (1947) published research that dealt with the more recent archaeology of the Arctic and still remains classic. It is easily recognized that many authors of the 1950s focused their scholarly works on tracing back the ethnohistory of the different ethnic groups populating the Arctic at present. That scientific tradition—founded by Okladnikov, Chernetsov, and Rudenko—later affected research done by R.S. Vasil'evsky, N.N. Dikov, and L.P. Khlobystin, who were students of Okladnikov in one sense or another. That tradition can be recognized in some recent publications, such as M.A. Kiryak's monograph (1993). Therefore, a new generation of Russian Arctic anthropologists retained the main features of research intellectually following the brilliant scholars of the 1950s.

But it should be stressed that the appearance of the Origin of the Native Americans by G.F. Debetz (1951), developing ideas advanced by Russian and American researchers of 1920–1930, was of great importance even among the excellent works mentioned above. Debetz, taking into consideration both archaeological and ethnographic data and physical anthropology as well, advanced for the first time in Russia a well-grounded hypothesis on the peopling of the American continent in the Late Quaternary, out of Northeast Asia across the Bering land bridge.

The abundance of hypotheses and theories advanced from the 1920s to the mid-1960s is, in my view, a characteristic feature of that period when concepts on Arctic archaeology were finally formed. Some of them are of historical interest now, but nevertheless it was necessary to move Arctic anthropology forward as a whole. It is worth noting that in Circumpolar Stone Age Jessing (1944), who applied Hatt's theory to archaeological data from both the Old World and the New, also believed that contemporaneous intracontinental and maritime Stone Age cultures existed in the Arctic Region. These ideas, subjected to careful examination, were strongly criticized in Russia by Gurina, Moshinskaya, and Khlobystin, who based their objections on abundant archaeological materials from the Russian Arctic; V.I. Moshinskaya (1965) published the most precise discussion of Jessing's theory.

As in the case of Jessing's hypothesis, A. Nummedall's views on the Pre-Glacial migration from Asia to Northern Scandinavia are of historical interest (Nummedal 1929) as well as an alternative to E.F. Greenman's theory of the peopling of America. The latter (Greenman 1963) considered Native Americans as direct descendants of Upper Paleolithic Magdalenians who had migrated to the New World from Europe in kayaks and canoes. In general, anthropologists negatively received these ideas; a discussion was published in Current Anthropology and only three people (of 18) were inclined to assume such a possibility. One of the supporting reviewers was Thor Heyerdall, who best illustrated Greenman's theory. It is worth noting that

Arctic anthropology has never lacked for fantastic theories, the most recent being advanced in the 1980s by Robert McGee, who assumed a migration of the ancestors of the Eskimos from Eastern Siberia westward to Greenland across the Arctic Ocean.

As for migration theories, H.-G. Muller-Beck's ideas (1966) still remain popular and suggest that a latitudinal migration of Eastern European Upper Paleolithic hunters penetrated ca. 28,000–26,000 BP ice-free areas of the American continent, moving from West to East across Eurasia.

Successful research of natural evolution in the Arctic during the Late Quaternary was carried out within this period (B.F. Zemlyakov, G.I. Goretsky, V.N. Saks, N.N. Urvantsev, S.V. Obruchev, M.M. Ermolayev and others), making it possible to recognize the most significant natural shifts such transgressions, glaciation, etc.—also of great importance for the development of Arctic archaeology in Russia. After review of the second historical period, one could conclude that the most significant achievement of that time, from the point of view of the Arctic archaeology, was the discovery of evidence dating back to the Paleolithic. In spite of that, permanent habitation in Trans-Polar, or Arctic regions—beginning from the Paleolithic—was doubted; Arctic areas were considered to have been settled mainly during the Neolithic (Okladnikov 1955:130; Bader 1966:104).

If former periods of Arctic archaeological research were marked by the activity of "metropolitan" scholars (primarily from Leningrad-St. Petersburg), the third, contemporaneous one is characterized by the appearance of regional archaeological centers in Murmansk, Syktyvkar, Yakutsk, and Magadan, founded in the early 1960s. At the same time, long-term research projects are progressing on the Kola Peninsula (N.N. Gurina, V. Ya. Shumkin), the extreme Northeastern European area, and the Taimyr Peninsula (L.P. Khlobystin). G.A. Chernov continues to collect in the extreme Northeastern European area as well. To my mind, it is preferable to discuss these results in detail for different reasons: first, the history of Russian studies in Arctic archaeology deserves special research, and second, the present study considers the latest results to some extent. They are presented briefly below according to the main geographic subdivisions:

## 1.1. Kola Peninsula

From 1960 to 1990, field projects continued to be carried out by the Kola Expedition of the Leningrad Branch of the Institute of Archaeology of the USSR Academy of Sciences (now the Institute for Material Culture History)—led by N.N. Gurina in 1965 and from 1969 to 1982, and later by V. Ya. Shumkin. Southern areas of the peninsula were surveyed by expeditions from the Karel Department of Academy (Gurina 1971, 1973, etc.; Anpilogov 1969; Pesonen 1978). The projects resulted in abundant materials illuminating general cultural evolution and aspects of peopling from the ancient Mesolithic stage, dated at least to 10,000–9000 BP (Gurina 1987, 1989; Shumkin 1986, 1988).

## 1.2. Extreme European Northeast (Malozemelskaya and Bolshezemelskaya Tundra Areas), Trans-Ural Polar Area, and Northwestern Siberia

Most of the materials come from G.A. Chernov's amateur collecting (1985) and from professional surveys and excavations by V.E. Luzgin (1973ab), V.S. Stokolos (1986, 1988), L.P. Khlobystin (Khlobystin 1967, 1977, 1984, 1987; Khlobystin and Korolyov 1969; Khlobystin and Lashuk 1986), and in part the present author (Pitul'ko 1988, 1991f). Assemblages are numerous but provide extremely unequal representation for different periods of the Stone Age. Nevertheless, it could be supposed that the first human groups penetrated into the area as early as 9000–8000 BP (Khlobystin 1973; Vereschagina 1973, 1990). Archaeological materials, both collected and excavated primarily represent the Late Neolithic–Early Metal Periods, and some stratified complexes are valuable for consideration. Some types of discovered ceramics and stone tools repeatedly allow defining cultures or cultural types that existed around the Late Neolithic–Early Metal Period boundary. The Ortino (Khlobystin, Pyadyshev 1962; Pitul'ko 1991c, 1991d) and Chuzhyayol (Stokolos 1988) archaeological cultures, which existed approximately contemporaneously, as well as the younger Choinovty culture (Stokolos 1988).

## 1.3. Taimyr Peninsula

Archaeological survey of the territory was undertaken for the first time by the Trans-Polar Expedition of the Leningrad Branch of the Institute of Archaeology of the USSR Academy of Sciences (now the Institute for Material Culture History), which was led by Leonid P. Khlobystin from 1967 to 1981. Stopped in 1981, the explorations were not resumed after his death in 1988. Khlobystin surveyed southern (though still north of the Arctic Circle) areas of the Peninsula, both west and east, and discovered a great number of archaeological sites—primarily in the Pyasina, Dudypta, Kheta, and Khatanga valleys. Some sites were discovered near large lakes such as Labaz and Khargy. The artifacts collected were primarily surface finds, but there were a few stratified assemblages among them too. The latter, characterizing different stages of the Stone Age, became a firm basis for precise examination of the materials set in a chronology with the cultural evolution of neighboring areas. Thus original Neolithic cultures such as Glubokoye Lake, Maimeche, and Baikit were defined, and their cultural interactions with contemporaneous Neolithic cultures of the Yakutian Region, and especially with the Late Neolithic Ymyyakhtakh culture. It was noted that, in general, cultural evolution in the Taimyr Region was permanently affected by the cultural phenomena that originated and developed in Yakutia. Initial migrations to the Taimyr Peninsula are dated to no later than 8000 BP (Khlobystin 1972, 1973a, 1973c, 1976, 1978, 1982).

## 1.4. Northern Yakutia

About 10 years after A.P. Okladnikov's survey, Yu. A. Mochanov and S.A. Fedoseeva, who are recognized leaders in East Siberian archaeology now, began their explorations in southern Yakutia by surveying the basins of the Vilyui, Aldan, and Olekma Rivers, which are the largest tributaries of the Lena River. A number of stratified sites were discovered there. Excavated materials made it possible to recognize regional cultural evolution and to elaborate upon a cultural chronology from the Upper Palaeolithic to the Late Neolithic Period. Summaries published by Mochanov (1977) and Fedoseeva (1968, 1980) are undoubtedly much more advanced than Okladnikov's speculations, which is not a surprise because of the excellent and abundant materials they have. The research was extended northward, where N.K. Vereschagin and Yu. A. Mochanov discovered the northernmost Late Paleolithic Berelekh site, located near the Berelekh Mammoth "graveyard" (Vereschagin, Mochanov 1971). Trans-Polar basins of the Anabar, Olenek, Indigirka, Yana, Alazea, and Kolyma rivers were surveyed by Mochanov's collaborators: I.V. Konstantinov, V.G. Argunov, and S.P. Kistenev. Mochanov, surveying Bolshoi Lyakhovsky Island in the southernmost island group of the New Siberian Archipelago, found an assemblage of Pleistocene faunal remains thought to be evidence of Pleistocene habitation on the New Siberian Islands.

## 1.5. Middle Kolyma River Area and Chukchi Peninsula

Professional archaeology was begun here by N.N. Dikov, who formerly surveyed the Eskimo sites along the coast. Assemblages discovered inland, though they illustrated some cultural definitions like the North Chukot and Ust-Belaya Neolithic cultures, were not numerous at first. Undoubtedly the area under consideration was populated (permanently or during some periods) much earlier than the Neolithic, but there was no evidence. The last projects, conducted there by Dikov from 1980 to 1991, were rather successful in that sense (Dikov 1980, 1985, 1990, 1993) but still failed to provide archaeological evidence of Late Pleistocene habitation near Bering Strait. The supposition that some materials are of Pleistocene age is, in my view, erroneous (Pitul'ko 1992a, 1993a), though a few indisputable and very interesting Early Holocene complexes were actually found. At the same time, cultural sequences of the Western Chukotka area, as it is known after M.A. Kiryak (1993), are better represented. Finally, very important materials were discovered by N.N. Dikov (1976a) south of the Arctic Circle; I refer to the Early Holocene Siberdik site located within the Upper Kolyma area. The Final Pleistocene–Early Holocene assemblages from Buyunda and Kheta, excavated by Sergei Slobodin (1992), and Druchak-B known from I. Vorobei (1992) are worthy of note too, though they and the Siberdik site are located to the south. Unfortunately, the above-mentioned assemblages are still fragmentarily published.

As can be easily seen, even a brief survey of Soviet-Russian studies in archaeology of the Arctic Stone Age gives real evidence of research activity and further progress during that time, from 1960 up to the present, and the period from 1960 to 1990 could undoubtedly be named the Golden Age of Russian Arctic archaeology. Several hundred sites including multilayer settlements were discovered, and a series of scholarly works dedicated to summarizing materials accumulated and giving information on poorly or non-investigated territories were published during that time (Argunov 1991; Dikov 1977, 1979, 1993; Kiryak 1993; Mochanov 1969, 1977; Stokolos 1986, 1988; Fedoseeva 1968, 1980). Some results were summarized in a series of articles (Khlobystin 1970, 1972, 1973, 1978). Problems of Stone Age Arctic archaeology have been considered in dissertations, based on the materials discovered (Argunov 1989; Vereschagina 1989; Dikov 1971; Kiryak 1989; Mochanov 1976; Pitul'ko 1995; Fedoseeva 1984; Khlobystin 1982; Shumkin 1984). A directory of the Yakutian archaeological sites was published by Mochanov's research team (Mochanov et al. 1983, 1991). N.N. Gurina and L.P. Khlobystin (Gurina and Khlobystin 1975; Khlobystin 1990) published a brief review summing up preliminary achievements in the Russian (Eurasian) Stone Age Arctic archaeology. Reviewing the studies of that period, one notes traditional features of research, intellectually going back to Chernetsov and Okladnikov, and very distinctly displayed in works by Vasil'evsky, Dikov, Kiryak, and Khlobystin. I refer to the tendency to apply archaeological data to the genesis of different Arctic ethnic groups.

To complete the historical review of Russian Stone Age archaeology, I must point out that during the last (current) period of its development in the 1970s and 1980s, some Arctic islands were surveyed by archaeologists for the first time, although research of that kind had already been carried out in the Canadian Arctic and Greenland and produced well-known significant results. As for the Russian Arctic, some islands of Franz-Josef Land (Ivanov 1993) were surveyed, Vaygach Island where artifacts supposed to be dated to 4000–3500 BP (Pitul'ko 1988) were collected as well as a later, small assemblage that is at least Mesolithic (Ivanov 1991). T. Tein excavated the Chertov Ovrag Paleo-Eskimo site on Wrangel Island (Tein 1981). But the most surprising results came during excavations at Zhokhov Island at 76° north latitude (Pitul'ko 1991, 1993a, 1993b); these are discussed in detail below. All of these findings provided new opportunities to discuss the problem of ancient migrations northward, into the High Arctic, and the problems of development of adaptations as well.

Unfortunately, the favorable tendencies in the development of Russian Arctic archaeology that took place in the 1970s and 1980s were interrupted by the well-known result of political and economic circumstances, and Arctic archaeology has now collapsed along with Russian science in general. Single, more or less successful projects carried out by Andrew Golovnev's team or by Yuri Mochanov in the Sakha (Yakutia) Republic, in contrast, only emphasize the sad state of the current situation. Nevertheless, the potential capabilities of Russian Arctic archaeology and science still remain high and I believe will soon be revived.

In a few words, the history of Russian Stone Age archaeology can be presented in a sequence of three periods:

1. Pilot period (from the late 18th century)—characterized by occasional collecting and extremely rare professional projects; the Arctic relics are recognized and presumed to be a subject of study. The natural upper limit of that period is the First World War.

2. Renaissance of Arctic archaeology in Russia—mainly in the late 1940s and in the 1950s. Advancing conceptual ideas became the background for further studies. Sporadic professional archaeological projects focused on certain areas. The leading role belongs to metropolitan (Leningrad-St. Petersburg, Moscow) scholars.
3. Contemporary period—beginning with the foundation of regional archaeological centers in the early 1960s. The Golden Age of the Russian Arctic archaeology was in the 1970s and 1980s, only to collapse in the 1990s. What is to come?

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If the results obtained in the Russian Arctic (with respect to Stone Age archaeology) were put on a map, it would appear as a mosaic; both the High and the Low Arctic have been studied unequally. The territories of the Kola Peninsula and Yakutian Region and in some respect the Taimyr Peninsula, are in the best position when compared with the whole Eurasian Arctic. For instance, very few finds of Stone Age tools are yet known in Northwestern Siberia. At the same time, abundant materials collected in the extreme European Northeast and in Northeast Asia are very difficult to consider. A great number of the collections are of little value since they contain a mixture of artifacts from different periods, which was caused by local peculiarities of sedimentation. Many assemblages do not include diagnostic artifacts.

Unfortunately, the description above could be applied to the continental Arctic area of the Yakut Region as well. That area is the closest territory neighboring the Zhokhov Island location. However, a few assemblages containing Mesolithic artifacts are known in Northwestern Yakutia, though most of them lack interest because of the absence of diagnostic tools. The same could be said about Northeastern Yakutian sites where, except for the famous Berelekh site, individual artifacts that look old have been collected at a few points. Later sites share the same features of spatial distribution.

Reviewing the results of Arctic archaeological research as a whole, it might be appropriate to cite A. P. Okladnikov, who as early as 1945 wrote that Arctic archaeological research is about 150–200 years behind geological research. Despite the progress attained, especially in the last three decades, these words still ring true.

# CHAPTER II

## Late Pleistocene Natural Dynamics and the Problem of Early Human Habitation in the Arctic

As is well known, the main distinctive feature of natural evolution in the Pleistocene was the alternation of glacial and interglacial stages of differing continuity. Spatial pulsations of ice cover, which became more extensive in continental and polar areas during glacials and decreased to the size of modern glaciated areas or less during interglacial epochs, were accompanied by sharp global eustatic changes in the world ocean level.

It is universally recognized that continental glaciations are of research interest as a natural phenomenon brought on by climatic changes in vast territories both in Northern and Southern Hemispheres, which influenced global ecological changes and natural (flora and fauna) evolution. Moreover, these glaciations are a transitory factor with considerable effect on the material culture of ancient people, their migrations, and the peopling of different areas. The possibility for initial human penetration into many regions, especially of the Eurasian Arctic and the North American continent, appeared for the first time during the last Late Pleistocene (Valdai—Sartan—Late Wisconsin) glaciation—according to available data, the coldest Pleistocene stage. Pointing out a peculiarity of that stage, A.A. Velichko (1973) called it "the third cryogenic stage of the Pleistocene," in contrast to the former "glacigenic," keeping in mind that expansion of continental and oceanic ice sheets did not exceed areas glaciated previously while aggradation of permafrost was very intensive.

A number of questions of Late Quaternary natural history in the Arctic, such as problems of the dynamics of glaciation and its range and continuity (for the Arctic as a whole and for some other areas as well) still remains disputable. A considerable group of researchers, based on evidence discovered through interdisciplinary research of Subarctic continental plains and the Arctic Shelf area, traditionally suppose (after I.P. Gerasimov and K.K. Markov) the existence of local Late Pleistocene ice sheets and separate glaciers to be obvious (Gerasimov and Markov 1939; Markov and Velichko 1967; Velichko 1973, 1979, etc.). Active phases of such local glaciers are assumed to be heterochronous, i.e., after N.V. Kind (1974:233) this could be called the "dynamics of heterochronous type."

On the other hand, an alternative hypothesis is proposed assuming, complete glaciation of the Barents Shelf and other shelf areas—or even the Arctic worldwide. This is the so-called Pan-Arctic Ice Sheet concept, which is surprisingly popular (Blake 1970; Hughes et al. 1977; Schutt et al. 1974; Astakhov 1978, 1982; Grosswald 1977, 1982, 1983). These ideas are strongly supported in Russia by M.G. Grosswald. At the same time, the available data, including geology, geomorphology, biogeography, and isotope chronology—in the view of Velichko, M.A. Faustova, and L.L. Isayeva—rather tend to support a theory of "multi-dome glacial systems centering to continental highlands and Arctic archipelagos" that also existed in the Eurasian and Canadian

Arctic during the last Late Pleistocene glaciation (Velichko et al. 1988:27, 28). Thus, discussing the environmental chronosequence corresponding to the glacial chronology, Velichko and coauthors are inclined toward the idea that the spreading of ice sheets in Asia that took place at the beginning of the Late Pleistocene was stimulated by the coherent effect of climatic conditions and Gulf Stream influence, and that the contemporaneous European glaciation was less extensive. Later, the cold climatic trend and progressing aridity also caused a reduction in Siberian glaciation and a drifting of the center of glacierization westward, closer to the North Atlantic Region. In the second half of the Late Pleistocene, during the maximal stage of glacierization, isolated "independent ice sheets having individual structural peculiarities and dynamics affected by the regional climatic conditions" (Velichko et al. 1988:27, 28) are supposed to have existed in North Eurasia.

It should be stressed once again that for present research the following features of the natural process in the Arctic during the Late Pleistocene are of great importance: the general range of the glaciation of continental and shelf areas, dimensional and chronological trends of the deglaciation that occurred in those areas, and sea-level fluctuations and landscape evolution both in periglacial zones and unglaciated territories. The problem of the Arctic shelf glaciation, being very complex, will be discussed separately.

## 2.1. North Scandinavia, Kola Peninsula, Northeast Area of the Russian Plain

Being the area covered by the central part of the continuous Scandinavian ice sheet, the abovementioned lands were deglaciated rather late and the dynamics of the latter has been well studied (e.g., Palaeogeography of Europe 1982; Puning and Raukas 1986; Velichko and Faustova 1982; Troitsky et al. 1979; Holtedall 1957; Koryakin 1988). Border glacial dislocations marking its northernmost spread have been observed within the limits of the Barents Shelf (Matishov and Pavlova 1988; Velichko et al. 1988). It was ascertained that its thickness, detected in sediments from mountain areas, did not exceed 400–500 meters, declining substantially from West to East (Armand and Nikonov 1963:55–60). Some areas, in particular the northern and western marginal Norwegian territories and the eastern localities of the Kola Peninsula, were not glaciated at all during that period and are supposed by some researchers to be probable refugia of certain species of fauna and flora of the Arcto-Alpine type (Andersen 1965:91–138). It is also possible that the White Sea was one of the largest refuges, the depression of which is assumed by V.G. Chuvardinsky (1992:117–124) to have been ice free during the Valdai epoch. This contradicts the traditional view about the Holocene deglaciation of the White Sea depression (Medvedev and Nevessky 1971). In Chuvardinsky's opinion, it could explain the survival of the relict species of flora and fauna, described by E.F. Guryanova (1948) as far back as 50 years ago. At the same time, there was the Ponoi Glacier in the center of the Kola Peninsula. The latter remained stable (almost stagnate) because of bed relief peculiarities (in Grosswald's

[1982] view and those of a few other researchers, the above-mentioned glacier can be considered a fragment of the Barents Ice Sheet). The recession of the Scandinavian glacier was rather intensive due to specific local climatic conditions, which occurred as a result of complex atmospheric interactions caused, on the one hand, by the continuous existence of an enormous mass of dead ice and its gradual melting, and by warm Atlantic water on the other (Armand and Armand 1965:255–257). Deglaciation of the Kola Peninsula was somewhat continuous. Natural conditions of periglacial type, according to Armands, occurred there no later than in the Allerode. The inner areas covered by the Ponoi Glacier were deglaciated much later, which is made clear by pollen associations dated no older than to the Boreal-Atlantic boundary. That is, the Ponoi Glacier had melted completely by the end of the Early Holocene (Vakorin and Kuptsova 1978:68–73). Although southern areas of the Kola Peninsula had been deglaciated earlier, they are assumed to have been of unfavorable conditions also because dead ice existed continuously in the Ponoi depression.

Based on the chronological sequence of the numerous series of diverse glacial formations and sediments marking the positions of marginal zones, the Scandinavian Glacier intensively decreased in size. The final stages of deglaciation have been precisely studied in Norway by K. Mannerfelt (1945). In that view, after the beginning of decomposition of the intact ice sheet, the most solid glacial domes corresponding to the highest peaks became local centers of glaciation. Later, the main ice massifs appeared to be located in the ancient cirque depressions formed earlier. Local glaciers are supposed to have disappeared in Norway during the Atlantic and Sub-Boreal periods (Andersen 1965:91–138; Puning and Raukas 1986:82).

The northeastern area of the Russian Plain was apparently a zone affected by the activity of certain glacial centers (Palaeogeography of Europe 1982; Quaternary Glaciation 1987). The dynamics of the Quaternary glaciation of that region still remains incompletely studied. Taking into consideration the dimensional orientation of the terminal morains and the petrography of morainic fragmentary material, Velichko suggests border glacial dislocations recognized as belonging to glacial systems centered in the Novaya Zemlya Islands and the Polar Ural Ridge, respectively (Velichko 1979:12–26; Velichko et al. 1988:30). At the same time, according to A.S. Lavrov's observations (Lavrov 1977:83–100), petrographic evidence of glacial boulder material of Scandinavian origin predominates in deposits comprising the latest Valdai moraine generation in the western part of the Pechora Lowland and Timan areas as well. The origin of the latter is thought to be related to the advance of the Kola-Mezen Distributary of the Scandinavian ice sheet. On these grounds, it might be possible to consider the northeastern area of the Russian Plain as a zone affected by a convergence of the Scandinavian and Novaya Zemlya ice sheets, represented respectively by the Kola-Mezen and the Barents-Pechora distributaries. The eastern territories were also influenced by the Ural center of glacierization. Authors advancing reconstructions such as those mentioned above—for instance A.S. Lavrov (1977) who needs to be noted first among them—consider recent radiocarbon dating of organics that are supposed to originate from the moraine-covered deposits discovered in a single section on the Lower Pechora River area (Arslanov et al. 1975; Grosswald et al. 1974), as evidence of significant glacial effects there during the Late Dryas, or probably in the Pre-Boreal. Therefore, in that view, a deglaciation of the northeastern Russian Plain area is assumed to be rather recent (Lavrov 1977:94). It is supposed that glaciers covered the northern area of the Pechora Lowland and adjacent shelf as far back as about 6000 BP (Lavrov and Arslanov 1977:128–132). Contrary to that, Velichko and coauthors consider a reconstruction of the above-mentioned to be rather relative because the Novaya Zemlya ice sheet was most likely not a complete chronological equivalent of the Scandinavian one, and it would be incorrect to correlate the maximal stage of the latter with the borders of the Late Valdai glacial episode of the Scandinavian sheet. According to Velichko, the maximums were chronosequent. The distributaries of the Novaya Zemlya ice cover extended to the northeastern area of the Russian Plain before the Scandinavian one, i.e., there was a zone of "asynchronous aggradation" affected sequentially by both glaciers (Velichko 1979; Velichko and Faustova 1987:42; Velichko et al. 1988:35, 36). That point of view is confirmed by the results of recent Late Pleistocene research of the Novaya Zemlya islands. The period of maximal expansion of the Novaya Zemlya ice sheet is thought to have taken place before the Late Pleistocene thermal minimum, and mountain valley glaciation is identified by the research as existing there most likely during the Final Pleistocene (Chizhov et al. 1968; Krasnozhen et al. 1982:40–52). Therefore, the existence of glacial conditions in the northeastern Europen Russian territories (or in some of them at least) seems doubtful for the final period of Late Pleistocene glaciation.

## 2.2. Sartan Glaciation of Northern and Northeastern Siberia

The interpretation of data on North Siberian glaciation is considered by many researchers (Velichko, Faustova, L.I. Isayeva, etc.) to be very complex. In popular view, the last glacial sheet advanced to northern areas of the West and North Siberian lowlands from the center located on the Kara Sea shelf (Astakhov 1980, 1982; Grosswald 1977, 1983; Arslanov et al. 1983; Dibner 1970; Voronov 1968; and others). Apart from the notorious concept of a Pan-Arctic ice sheet, these views are grounded in the sub-latitudinal orientation of border glacial formations that are supported by observations of the sub-meridional direction of transportation of fragmentary material, the origin of which is thought to be related to the Novaya Zemlya islands (see, for instance, Astakhov 1982:16–21). However, a chronology of these formations is not clearly defined, which is pointed out by the opponents (Velichko, I.D. Danilov, Faustova) of the above-mentioned researchers. Thus, V.I. Astakhov is recently inclined to assume that the border formations known in the Yenisei area of Siberia are of Pre-Sartan age (Astakhov and Isayeva 1985:438–440). There is evidence of the origination of northwestern Siberian fragmentary material from the Polar Ural and Pai-Khoi Ridges (Boykova et al. 1982:22–27; Velichko 1979; Danilov 1978), and evidence of the advance of glaciers in the Yamal area northward and to the northeast of the Yamal Peninsula (Tarnogradsky and Kaplyanskaya 1975). Taking these data into consideration, Velichko tends to assume an isolated center of glaciation in the Polar Ural Ridge area (Velichko et al. 1988:35, 36). One scenario, rather close to V.N. Sacks's (1948) views, is thought to be more or less realistic for other Siberian areas. According to this scenario, it is assumed that a small ice sheet (with valley glaciers distributing westward, southward, and eastward in part) existed on the Mid-Siberian Tableland (on the Putorana Plateau, to be exact). The ice dome is suggested to have been about 200 m thick and 200–250 km in diameter; valley glaciers extended 50 to 80 km. Judging by the expanse of recent end moraines discovered on the Anabar Plateau, valley-type glaciers existed in the highest part (800–900 m elevation) of that area too. As far as the Taimyr Peninsula is concerned, glaciation covered the eastern (highest) part of the Byrranga Mountains, typified by reticular glaciation. Permanent snowfields, snow glaciers, and small valley glaciers were most likely characteristic of the West Byrranga area (Velichko et al. 1988:31).

In Northeast Asia the greatest range of glaciation is identified in the Verkhoyansk Ridge area, where reticular valley glaciation existed during the Late Pleistocene. The Suntar-Khayata and Chersky Ridges, and the ridges composing Koryak Upland system as well—where valley-type glaciers existed—are thought to have been other local centers of glaciation. No fewer than four stadials have been identified during the period from 33,000 to 11,000 BP (Bespaly and Glushkova 1987; Glushkova and Prokhorova 1987; Izbekov 1982).

## 2.3. The Problem of the Pan-Arctic Ice Sheet

As already noted, there is another theory advanced that is contrary to the moderate views on the range and chronological and dimensional trends of the last glaciation in the Arctic. That concept, first advanced by V. Shutt, G. Hoppe, and W. Blake in 1968, was later supported by another group of authors (Grosswald 1977, 1982, 1983; Astakhov 1978, 1982; Blake 1970; Hughes et al. 1977). In general outline, the concept could be presented as follows:

1. Range of the glaciation. The ice sheet is thought to have spread from Greenland to the northeastern extremity of the Taimyr Peninsula, covering the mainland and continental shelf areas. In this case, the glaciers occupy the shelf zone including the Barents and Kara shelf areas, and White Sea depression as well, transforming into giant floating glaciers (about 1–1.5 km thick) in the deep-water areas of the Arctic Ocean. The total volume of the glaciers is estimated to have been 50 million cubic kilometers—what corresponds to a decrease in the world ocean level of 125 meters (a deep regression of the Arctic Ocean and a general decreasing of the world ocean level took place during the last glaciation).
2. The maximum. The maximal stage of the last glaciation is correlated to 18,000–20,000 or 14,000–16,000 BP, and the duration of ice cover is assumed to have taken 10,000 years more. It is believed that the decomposition of the mainland and shelf glaciers was stormy and almost contemporaneous, which brought on the catastrophic transgression of the world ocean that occurred in the Early and Middle Holocene.
3. Besides the continental one, some centers of glaciation are supposed to have existed in the Barents, Kara, and probably East Siberian shelf areas. Glacial conditions in the main part of the continental and oceanic Arctic are thought to have continued up to the Mid-

> Holocene, and the glaciers composed "the general dynamic system of the Arctic Ice Super Sheet" (Grosswald 1983; Arslanov and Lavrov 1977).

There are two primary indisputable facts used by the authors for grounding the concept: (1) data on a significant drop in temperature that took place during the Late Pleistocene, and (2) data on the deep regression of the world ocean during that period. Interpreting these data, researchers try to support the concept by observations on glacial and geomorphic geology in the region under discussion. But the latter could be construed differently, as observed by their opponents (Velichko, Danilov, V.M. Makeyev, G.G. Matishov, and others).

Thus, Danilov (1982, 1988) notes that the correlation of the Late Pleistocene oceanic regression with the drop in temperature itself is by no means a basis for certain development of circumpolar glaciers; it only points to the possibility of the emergence of newly born glaciers or to stimulation in the growth of former glaciers. Moreover, a somewhat specific combination of geographic conditions (such as local average temperatures and temperature trends, height above sea level, annual precipitation, atmospheric circulation) are necessary for that possibility to be actualized somewhere. For instance, the increasing of climatic rigor in Northeast Asia meant the aggradation of permafrost. G.G. Matishov, Velichko, V.D. Dibner, G.I. Lazukov and other researchers have noted the incorrectness of M.G. Grosswald's conclusions based on the data of the geomorphology of the ocean floor and glacio-isostasic vertical shifts (Velichko and Faustova 1982:11; Matishov and Pavlova 1988:13; Dibner 1970; Lazukov 1972). Excepting above-mentioned ambiguous interpretation of the age of morains studied in northwestern Siberia (Astakhov and Isayeva 1985:438–440), the petrography of fragmentary material (Boykova et al. 1982:22–31), and the results of fossil glacier ice research (Kaplyanskaya and Tarnogradsky 1975), there is some direct evidence refuting the Pan-Arctic ice sheet concept. None of them could be explained by the logic of that theory.

Thus there is abundant evidence of the rather modest range of the Late Pleistocene glaciation discovered on polar archipelagos (Franz-Josef Land, Spitzbergen/Svalbard), which would have been strongly affected by the enormous ice sheets composing an "Arctic glacier." For instance, two or three isolated ice domes are supposed to have existed on the easternmost and northwestern islands of the Franz-Josef Land archipelago in the Late Pleistocene. The expansion of the glaciers did not reach the coast lines (Troitsky et al. 1979:401–407). Glaciation on the western part of the archipelago (as well as on the southern part) was probably of the sparsest character inasmuch as the reference column sections studied from the western part of the archipelago contain deposits accumulated during the interval of 40,000 to 50,000 BP that are not covered by morainic sediments. Data concerning the formation of 80–100-meter-high marine terraces from the period 20,000 to 25,000 BP are revealed both on the south and west of the archipelago and correspond closely to all of the available information on origin and chronosequence of marine terraces of Franz-Josef Land, which are repeatedly supported by a series of radiocarbon dates (Troitsky et al. 1979: 401–407; Salvigsen, Osterholm 1982:97–115). In the view of Velichko and coauthors, these data point indisputably to a short expansion of the Late Valdai glaciers on the archipelago, which was not related to the activity of the Scandinavian ice sheet (Velichko et al. 1988:33).

No less important observations were done on Spitsbergen archipelago, the Novaya Zemlya Islands, and on Vaygach Island. There are marine terraces rising to 40 meters in height represented extensively in the Spitsbergen littoral zone. The absolute chronology of the marine deposits of Spitsbergen archipelago is grounded in a series of radiocarbon dates covering the interval 28,000 to 44,000 BP (Salvigsen 1979:209–224). At the same time, the marine deposits of the 84-meter-high terrace have an absolute age of 18,000 to 21,300 BP; the terrace series, which varies in height from 6 to 60 meters, was dated at 4000 to 10,500 BP. The radiocarbon chronology for the terraces is corroborated by complete correlation of its trend with the sequence of absolute elevations. Consequently, the littoral zones of the archipelago were submerged but not glaciated during the intervals 28,000–44,000, 18,000–21,000, and 4000–10,500 BP (Danilov 1988:75). Marine terraces, well expressed in relief and dated older than 18,000 BP, which contain remains of marine mollusk fauna, are of most interest in connection with the Late Pleistocene glacial episode under discussion. According to Yu. A. Lavrushin, the sediments composing these terraces were not covered by glacial deposits and were not redeposited by a glacier; there are no topographic forms characteristic of a glacial landscape. Worthy of note is the fact that a gully covered by marine deposits and dated to 35,000–40,000 BP was found on the southern coast of Lady-Franklin-Fjord (Lavrushin 1969). After formation, the gully was never covered by a glacier.

A sequence of the marine terraces ranging from 60 to 300 m in height was revealed on Novaya Zemlya Islands that is also of the Late Pleistocene age. Similar to terraces of Franz-Josef Land, no evidence of glaciation was found there either. Marine mollusk faunal remains, occurring everywhere, were discovered on Vaygach Island to the highest elevation (162 m above sea level), which negates the possibility of extensive glaciation of that area in the Late Pleistocene as well (Krasnozhen et al. 1982:40–52; Chizhov et al. 1968).

The theory of intensive expansion of a Pan-Arctic ice sheet about 18,000–20,000 BP is the basic assumption of its advocates, who acknowledge that the Barents and Pechora shelf areas, as well as adjacent coastal plains (including the Pechora lowland), were completely glaciated up to the great latitudinal upland meander of the Pechora River. The beginning of the decomposition of the marginal zone of the sheet is thought to have taken place about 12,000 BP and, in accordance with that view, radiocarbon dates coming from the deposits are interpreted as sub-morainic. The latter, in its turn, is recognized as evidence of the active glacier that existed there up to 9000–10,000 BP, with the terminus dating to 6000 BP (Grosswald 1983; Lavrov, Arslanov 1977).

However, as noted by Danilov (1978, 1988), these views are in direct contradiction to geomorphological data on the composition of the Pechora shoreland area (Danilov 1988:76, 78). A sequence of four marine aggradation terraces is revealed there that are widely extended and have 40–60, 16–20, 8–12, and 3–5 meter heights, respectively. The fourth one is of special interest. The deposits of the latter are represented by irregular coarse sands containing sea mollusk and foraminifera faunal associations. The terrace can be easily recognized as a topographic form; its surface has no glacial disturbance or other evidence of glaciation. Terraces of that level are known all through northern Eurasia on any coastal lowlands of stable tectonic areas. As a rule, that terrace level is correlated with Pleistocene transgression (the Karga transgression, according to Sacks) whose sediments began to accumulate about 55,000–50,000 BP (Sacks 1948; Danilov 1978, 1988, etc.). Research of terraces on the Kara Sea coast, in northwestern Siberia, on the Taimyr Peninsula, and the North Siberian lowland also gave completely analogous results. The terraces studied are characterized by marine mollusk fauna and carbon dates ranging from 20,000/24,000 to 42,000 BP (Badinova et al. 1976:154–167; Zubakov 1972; Danilov, Parunin 1982:402–404; Isayeva et al. 1980:191–197; Kind et al. 1978:191–199). Inasmuch as it is impossible to assume a Holocene origin for the terrace succession, including the highest one, it would be reasonable to conclude that glacial conditions related to the activity of the Barents and Kara centers of glaciation never existed in those areas in the Late Pleistocene or, even more, in the Holocene.

Bedded deposits comprising the third terrace were studied on the Yamal Peninsula as well. Those strata consisting of peat, sand, and aleurite deposits are dissected by solid vertical ice veins. Peat sampled from the layer was carbon dated to 24,000–25,000 BP, and also there was no evidence of deformation of the ice veins found (in their upper part, at least) that could possibly be explained by the activity of the Kara Glacier (Danilov 1978, 1988). Further, peat bogs were discovered on the west coast of the peninsula that contain macro fossils of an arborescent birch (stem diameter 7–9 cm) carbon dated to 16,500 BP (Zubakov 1972). Peat bogs dated to 15,000–16,000 BP are numerous. These indicate that the Yamal Peninsula, at present covered almost completely by tundra, was covered during the period under discussion not by a glacier but by forest-tundra vegetation (Danilov 1988:78). It is very characteristic that pollen associations from the peat bog surveyed near the Baidara Bay coast and dated to 15,500 BP are distinguished by pollen frequencies that are typical of regular forest-tundra complexes (Badinova et al. 1976:154–167). These data testify that periglacial tundra vegetation occupied the Taz and Gydan Peninsulas during the last glacial too (Avdalovich, Bidzhiyev 1984:70–73). What is more, glacial effects were absolutely impossible near the Pleistocene-Holocene boundary, which is attested to by the well-known Yuribei Mammoth, dated to about 10,000–9600 BP (Yevseyev et al. 1982:19; Arslanov et al. 1982:35, 36). Tundra landscapes with sparsely wooded larch localities (these are present about 200–300 km south of the Yuribei River today) were contemporaneous with the Yuribei mammoth (Yevseyev et al. 1982:19; Ukraintseva 1982:29–36).

No less convincing data disproving a supposition on “the expanded ice sheet covering the North Siberia region” were revealed on both the Taimyr Peninsula and in the eastern Arctic islands. Thus, peat-bog sediments containing diverse floral macro fossils, as well as pieces of wood, were discovered in the piedmont area of the Putorana Plateau, which is supposed to be one of the centers of the hypothetical glaciation. A peat bog located on the 40–50-meter-high terrace is carbon dated to approximately 16,000 BP. It is revealed that larch, birch, alder, raspberry, and herbs of northern taiga associations comprised the vegetation complex of the area at that time (Badinova et al. 1976:154–167). As Danilov notes, the interval from 16,000/18,000 to 35,000/40,000 BP has been studied especially well in the western Taimyr, where no evidence of recent glaciation has been found (Danilov 1988:79). It has also been established that a transgressive phase of Taimyr Lake (the greatest body of water on the peninsula, located in the mountain region) took place in the period from 11,000 to 30,000 BP, while the North Siberian lowlands were affected by the Karga transgression of the Arctic Ocean from 20,000–50,000/55,000 BP (Danilov and Parunin 1982:402–404). Finally, unique data characterized by continuous accumulation of lake sediments were obtained from a 28-meter column near Sabler Cape at Taimyr Lake. The lithologically uniform strata of bedded sandy loam with fragmentary peat interlayers of carbon has no stratigraphic breaks. A series of carbon dates shows that the cover was accumulated during the interval from 12,100 to 30,300 BP (Kind et al. 1978:191–199; Kind et al. 1981:184–189).

The above-mentioned data do not support ideas about the glaciation of the area nearly as well as materials discovered on the high-latitude eastern Arctic islands.

Thus, for the islands of Severnaya Zemlya (North Land), where at present about 50% of the area is covered with glaciers, it has been established that glaciation was less expansive there during the thermal minimum of the Sartan temperature fall (about 18,000–20,000 BP), i.e., the Sartan glaciation of that area was of smaller range than the modern one (Makeyev et al. 1979; Makeyev and Pitul'ko 1991). This supposition is confirmed by certain important facts: glacial topographic forms and glacial deposits of Sartan Age have limited expansion on the islands of North Land archipelago; no significant recent (Holocene) glacioisostasy shifts have been observed; Pleistocene faunal remains (mammoth) are well represented on islands being dated to 11,500 BP and from 19,000 BP to 24,000; and pollen associations with herbs (cereals and sedge) predominating are contemporaneous with dated mammoth bones. Further, there are soil horizons and bog lake deposits containing peat lenses found in the ice-free area and in the glaciated territories as well. These sediments are carbon dated in general from 8800 to 11,500 BP, and the peat horizon dated to the interval 9000 to 10,200 BP contains macro fossils of willow and birch shrubs. The horizon is characterized by a spore-pollen complex with a maximal, for the whole Holocene, content (up to 40%) of pollen of shrubs, which makes it possible to assume the average July temperature to have been about +5–+7°C and to consider the interval of the above-mentioned as the most favorable period for floral development that ever occurred in the Holocene (Makeyev 1983).

Recent research does not confirm the idea of a solid Sartan age ice sheet that expanded over the shelf area around the New Siberian archipelago. Thus glacial deposits of Sartan age have not been discovered on Kotelny Island although that island, largest of the archipelago, could be discussed as the most probable center of glaciation because of its dissected hilly relief with absolute elevations ranging up to 374 meters (Makeyev et al. 1989). In contrast, deposits of Sartan age that are widespread on Kotelny are represented by a bedded aleurite cover composed of deposits from boggy lakes and of aeolian origin, which are dissected by polygonal ice veins. These sediments are saturated with macro fossils of grass roots buried vertically in situ and contain bone remains of the mammoth faunal complex that are dated in sequence from 12,700 to 19,900 BP. Pollen complexes coming from these deposits are distinguished by a significant dominance of sedge and cereal pollen grains. Macro fossils of shrub trees (stem fragments up to 15 cm in diameter and twigs) are characteristic to Early Holocene deposits dated from 9000 to 10,000 BP, as well as to analogous horizons studied on the North Land islands. Similarly, these layers are characterized by the maximal content of arborescent vegetation in comparison with the other Holocene strata. This maximum is reflected even more sharply in the New Siberian reference sections inasmuch as the frequency of arborescent pollen grains reaches up to 80%. In sum, it can be said that these remarkable peculiarities of pollen associations make it possible to consider the interval from 9000 to 10,000 BP as the Holocene climatic optimum that occurred at that time in Siberia in the high Arctic and in the Subarctic coastal plains as well.

Glacial topography and deposits of Sartan age have been discovered only in the northern New Siberian Islands area. The specific locations are on Bennett and Zhokhov Islands in the De Long archipelago (the northern group of the New Siberian Islands). However, if Sartan glacial deposits cover an expansive area on the northernmost Bennett Island, where modern glaciation is rather extensive (Verkulich et al. 1989), its expansion is restricted to the central, uppermost part of the island. Due to coverage by peat-bog sediments of different thickness, it was ascertained that slope glaciers disappeared from Zhokhov island about 11,000 BP (10,960 ± 330, LU-2516), while uplands and cirques became ice free 9700 BP (9700 ± 80, LU-2497). Pollen data correspond exactly to the results obtained on the other islands of the archipelago and on a North Land one as well (Makeyev and Pitul'ko 1991; Makeyev, Pitul'ko, and Kasparov 1992).

Worthy of note is the fact that mammoth bone remains were discovered on Bennett Island and dated to about 13,000 BP (Verkulich et al. 1989). Although there is no glacial topography corresponding to the last glaciation recognized on Wrangel Island (V.M. Makeyev and S.L. Vartanyan, personal communication), there are a lot of mammoth bone remains, including the anomaly of young specimens; carbon-14 dates range from 4000 to 20,000 BP (Vartanyan et al. 1993:339).

In my view, the cited facts strongly contradict the concept of a Pan-Arctic ice sheet. They are a good illustration of the theory advanced by Velichko. In his opinion, the last glaciation in the Arctic was of small range, centered on uplands and polar islands, i.e., it was a multidome system composed of isolated elements (caps and glaciers), and the latter generally had asynchronous expansion phases. Proposing that reconstruction, Velichko bases his theory on the concept of Gerasimov, Markov, Sacks, and S.A. Strelkov, who considered localization of centers of glaciation in the uplands as collectors of solid precipitation (Gerasimov and Markov 1939; Sacks 1948; Strelkov 1968). Views on the asynchronous character of events comprising Late Pleistocene glaciation are an important element of Velichko's theory as well. They appeared to be attested to both in the European (Novaya Zemlya Islands) and in the American (Canadian) Arctic, where some features of the multidome system are recognized. It has been established that glaciation was less extensive on some islands than was formerly believed, as well as the asynchronism of local stadials (Velichko et al. 1988:38–40). Available data are assumed by Velichko to disprove the idea of the stability of the single-dome Lawrence ice sheet (Hughes et al. 1978:596–602).

Therefore it seems possible to consider the range of the last Pleistocene glaciation in the Arctic to be rather modest. Scandinavia was the most glaciated area, whereas the range of glaciation on the Polar Ural territory and Novaya Zemlya Islands still remains rather unclear. The problem of deglaciation, and the chronology of deglaciation, appear not to be important at all for the main part of the Eurasian Arctic, though eustatic sea-level changes much more strongly affected Late Pleistocene natural processes in the eastern Arctic. Because of the deep (down to 125 m and more, according to various views) regression of the Arctic Ocean that took place in the Late Pleistocene, a vast shelf area was exposed that became accessible for occupation by flora and fauna, and for peopling by prehistoric mammoth hunters. Due to the drop in sea level, the Bering Land Bridge appeared and the peopling of the American continent became possible. Keeping in mind the bone remains of the mammoth fauna complex, the most distant localities, such as Bennett Island (at 76°N), were accessible at least for mammoths.

The natural environment of northern Eurasia during that period is characterized by rigorous conditions expressed sharply in the thermal minimum episode dated to 18,000 BP. Thus for the territory of Russia only three zones are recognized—Arctic, Subarctic, and Temperate, whose borders appear to have been shifted substantially southward. The shifting was most intensive in the northern Eurasian continent, where vast areas were occupied by Arctic deserts and semi-deserts, while the belt of the tundra landscapes expanded as well. It was recognized that arborescent vegetation was strongly repressed (Avenarius and Muratova 1978:37). However, the latter was not completely supplanted. The precise periglacial conditions were characteristic for the areas bordering the margins of the expanded ice sheets, whereas landscapes of sparse woods of larch-pine-birch composition were located only a short distance from the glaciers (according to data on the Russian Plain presented by V.P. Grichuk (Palaeogeography of Europe 1982). For instance, deciduous forest landscapes are supposed to have existed no farther than 60 km southward from the glacial margin (Gruger 1974). Spruce trees at a distance of 300 km from the ice sheet have been recognized by some authors of the East European region (Serebryannaya 1972; Serebryannaya and Ilves 1974; Serebryanny 1974). Vast open landscapes of tundra-steppe type—developed under the conditions of a sharply continental climate—were characteristic of the North Siberian territories, including the polar islands located in the then-drained Arctic shelf zone (Makeyev et al. 1989:68). Researchers consider a decreasing trend in glaciation and climate humidity from west to east as a peculiar feature of that period. The opposite (increasing) trend is observed for the continental nature of the climate and for aggradation of permafrost. It is recognized that differences with respect to the modern epoch are decreased in the direction from Europe to East Siberia, which is explained by the effect of an increasing trend in continentality, i.e., continental climatic conditions stabilize landscapes (Avenarius and Muratova 1978:40). It is supposed that the latter could be affected by high summer temperatures that are characteristic for the areas of continental climate even during cold epochs.

However, these conditions occurred during a relatively short period and, since the epoch of global increase in temperature, a rising of biological productivity on the landscapes is believed to have taken place in many regions. The latter is marked by a northward shift of arborescent vegetation, recognized by pollen associations and macro fossils belonging to layers dated to the interval 16,000 to 12,000 BP. These facts are noted both for continental territories (the Yamal and Taimyr Peninsulas and the North Siberian coastal plain) as well as to the high Arctic islands (Danilov 1988; Makeyev et al. 1979, 1989; Tomskaya 1989; Danilov and Polyakova 1989; Boyarskaya et al. 1989; Kaplina and Lozhkin 1982; Lozhkin 1976, 1977). The general features of the present drainage systems were formed during that period as well. Thus, it is supposed that the channels of a number of rivers in central Yakutiya were created about 15,000–14,000 BP (Katasonova and Zigert 1982:132).

It is well known that the most important changes in the natural environment took place during the Holocene. The period as a whole has been studied in great detail in some territories. Some schemes reconstructing regional trends of changes have been defined (Danilov and Polyakova 1989; Boyarskaya et al. 1989)—as well as a study of the transcontinental correlation of Holocene climatic changes in Eurasia (Khotinsky 1977). Landscapes changed substantially during the first half of the period, especially when the border of arborescent vegetation shifted far northward. A rise in temperature occurred most clearly in northern Europe but later than in the eastern Arctic, where the optimum took place about 9000–10,000 BP. The tundra zone was represented by a narrow belt along the coast of West and East Siberia. Data have also been obtained that characterize a succession of environmental changes in the direct vicinity of some archaeological sites (Khlobystin and Levkovskaya 1973; Mochanov and Savvinova 1980; Tomskaya and Savvinova 1970; and others; Makeyev et al. 1992), which is important inasmuch as these successions can be correlated with the trends of cultural evolution in the area. But in this case, based on the primary research task of the present study, the general trend of environmental changes, and especially the asynchronism of the climatic optimum, that occurred in the Arctic seems to be the most significant feature of the Holocene environment.

In general, the Holocene environmental conditions in the Arctic and Subarctic areas, compared to those of the Late Pleistocene, appear to be favorable for peopling. On the other hand, though a generally favorable tendency occurred, a detailed examination of natural conditions in some regions shows that local environmental trends, both positive and negative, that strongly affected local cultural evolution and adaptations. Thus during the Sub-Atlantic period, local climatic deteriorations occurred that determined cultural evolution in some regions (to be discussed in Chapter V).

## 2.4. Peopling of the Arctic. The Problem of Antiquity

It is known that due to the above (see Chapter I) unevenness of archaeological research in the Arctic, where only a few areas are well studied, the problem of the antiquity of peopling, as well as the question of the limits of the area occupied, are rather topical. With regard to Scandinavia and the Kola Peninsula Region—territories well-studied both in the palaeogeographic and the archaeological sense—where available data make it possible to estimate them to have been peopled about 10,000 BP (Shumkin 1988). These questions need only to be defined more accurately. Moreover, they still need be clarified for many Arctic and Subarctic regions of Eurasia.

Thus data on the early stages of human occupation of the northeastern European trans-polar areas are extremely scanty. The problem of the early peopling of the region is most topical and closely connected with questions of its Late Pleistocene natural history—such as the dynamics, expansion, and duration of the last glaciation as well as the chronology and dynamics of deglaciation. The range of the latter, as mentioned above, can be considered in a different way. If the ideas of Grosswald and like-minded researchers are accepted, the initial period of human penetration into the extreme European northeast can not be dated earlier than 5000 or 8000–7000 BP. On the other hand, assuming the hypothesis advanced by Velichko, who supposes the asynchronism and scanty range of the Late Valdai glacial episodes, it is possible to acknowledge the Late Valdai peopling of the region, although there is no direct archaeological evidence for it. The early sites of the extreme European northeast are dated generally to 8000–9000 BP by archaeologists (Vereschagina 1990; Volokitin 1986). At the same time, research carried out by V.I. Kanivets (1976), B.I. Guslitser, and P. Yu. Pavlov (1987, 1988), indicates that there is a group of indisputably Palaeolithic sites (including the Byzovaya and Medvezhya [Bear] Cave sites) discovered on the nonpolar territories of the region under discussion. The Bear Cave, like the Byzovaya site. It is one of the northernmost Paleolithic sites, is dated by Guslitser and Pavlov to a mid-Valdai age, considering the results of isotope dating to be erroneous (Guslitser and Pavlov 1988).

Palaeogeographic data obtained recently on the extreme European northeast show that the natural environment of the Late Valdai period was probably comfortable for human habitation. Adhering to just that position—grounded on the ideas of Velichko, A.I. Golikov, Danilov and O.A. Skarlato—G.V. Ivanov takes into consideration findings from the Vaygach Islands collected near Lito-Sale Cape and at other points where few (nondiagnostic) artifacts were collected. Surface finds are represented mainly by intact and fragmented (or truncated) prismatic blades, some partly retouched, as well as retouched flakes, a core, and stone tools—a scraper and a chisel-like tool (Ivanov 1991:117, 118, Fig. 1; Ivanov 1993:48, Table 1). In Ivanov's view, some of the above-mentioned artifacts and tools can be viewed as typological analogies to specimens from the Bear Cave assemblage. Not to refute the similarity pointed out by Ivanov, who tends to date the Lito-Sale site to 18,000–20,000 BP or older, I would like to note that dating based on typological grounds appears to be generally disputable—a fact well known in archaeological practice. Thus, typological dating of the Lito-Sale assemblage and other Vaygach finds that are supposed to have a more or less ancient age, even if supported by the paleogeographical data interpreted according to Velichko's theory, could be erroneous for obvious reasons. The primary argument on which Ivanov's views are based, regarding substantial antiquity for the Lito-Sale artifacts, is the question of the accessibility of the island in the Late Pleistocene. In that respect, the researcher is inclined to correlate the early peopling with some stage of a deep pre-Holocene regression of the Arctic Ocean. The latter is really of great importance for discussion—for instance, the problem of the Late Pleistocene populating in the eastern Arctic. However, the area under consideration (Vaygach Island) is located at a minimal distance from the mainland, being separated by the narrow (5–8 km wide) Yugorsky Shar Inlet; thus there is no need to suppose dependence between the penetration of hunting groups onto the island and its direct connection with the mainland. It is noteworthy that the territory was permanently available for a very long time, for instance, by shore ice in winter.

Still, it is obvious that these materials (especially assemblages including perfect prismatic blades) mark an early stage for the peopling of polar islands in the western (European) Arctic inasmuch as disappearance of the blade industries in the extreme European northeast is dated to about 5000 BP; therefore blade assemblages must be dated earlier. It should be noted that before Ivanov's survey, sites believed to be from the Late Neolithic or Early Metal Period were thought to be the earliest on Vaygach Island. These sites, discovered by the present author on the northeastern extremity of the island, were dated to about 3500 BP (Pitul'ko 1988b:46–51). Isolated blade finds were collected on its south, which made it possible to expect that older material would be found (Khlobystin 1987). As for other artifacts (Ivanov 1993:47–54, Fig.1, Table 2–4) recently collected in the European Arctic, the finds are either chronologically nondiagnostic (artifacts from the Franz-Josef Islands) or of indisputably late age (collections from the Novaya Zemlya Islands). Still, one cannot help but note the interesting stratified site discovered by Pavlov while surveying the shore land in 1993 on Yugorsky Shar Inlet, where a blade industry associated with sea mammal fauna remains were found in situ for the first time in the extreme European northeast. The finds, believed to be from the Mesolithic or Early Neolithic, are preliminarily dated to no less than 5000–6000 BP (P. Yu. Pavlov, personal communication). So even the few archaeological materials known from the territory under consideration do not correlate well with the idea of a strongly expanded glaciation that continued up to the Mid-Holocene. In contrast, these materials show that the initial peopling of the region can currently be dated to as early as 6000 BP. In fact, these territories were most likely available and populated around the Pleistocene-Holocene boundary.

The northwestern Siberia region is remarkable for sparse surveying, even on the generally poor background of Stone Age archaeology in the Arctic. The only evidence of relatively early migrations to the Arctic Circle latitude is the Korchagi 1-B assemblage, discovered by L.P. Khlobystin near Salekhard (Khlobystin 1987:108–111), which is dated to 7260 ± 80 BP (LE-1376). But paleogeographical data obtained in the territory in recent decades and discussed above make it possible to expect earlier sites to be found there since that area was not glaciated or glaciation was rather scanty. In fact, northwestern Siberia was a regular ecological niche in the Final Pleistocene available for Paleolithic hunters—a periglacial tundra zone populated by mammoth fauna; near the Pleistocene-Holocene boundary the natural conditions were more favorable than at the present.

Another large territory of the Russian Arctic—the Taimyr Peninsula—is studied in archaeological regard much more thoroughly than the neighboring western Siberian North, although Khlobystin (1982) has surveyed mainly its southern area. On his expeditions numerous archaeological sites located in the Pyasina, Dudypta, Kheta, and Khatanga River basins were found between 1966 and 1981. A large number of them are relatively late. Considering early migrations to the territory, Khlobystin points out the assemblages from the Pyasina River sites (Pyasina I, III, IV, V; Lantoshka II site; Malaya Korennaya II, III; Kapkannaya II) and the Tagenar VI site—"the only site precisely dated." The latter, carbon dated to 6020 ± 100 BP (LE-884), marks the upper chronology of the Taimyr Mesolithic (Khlobystin 1982:8). At the same time, it is rather probable that the peninsula was peopled much earlier. Such a suggestion can be based on a surface find collected on the second valley terrace in the Pyasina River valley, near the confluence of the latter with the Polovinka River. A chopper-like tool made of greenstone flinty rock was found there. Artifacts similar in style and in raw material to the Polovinka find, as Khlobystin notes, are characteristic of the Afontovo and Kokorevo cultures belonging to Yenisey province of the Siberian Late Palaeolithic. Assuming that Tagenar VI and the other Mesolithic sites are not actually the earliest on the Peninsula, Khlobystin considered the possibility of its peopling (or at least the peopling of some territories) about 12,000 BP (Khlobystin 1982:3, 4) This is confirmed now by recent data on the natural history of the Taimyr–North Land Island region in the Late Quaternary, refuting the idea of an expanded last glaciation (Badinova et al. 1976; Danilov and Parunin 1982; Makeyev et al. 1979, 1982; Makeyev 1983).

In that connection one cannot help but note the finds collected by the present author while surveying the northern Taimyr area in 1993 (I was able to participate the Russian-German field project of the Arctic and Antarctic Research Institute [St.Petersburg] and the Alfred Wegener Institution [Potsdam]). The most interesting results were obtained while surveying the southeastern coast of Engelgardt Lake, where Pleistocene (?) faunal remains were exposed in a denuded section of the first terrace. Numerous bone fragments were collected in an extremely small area (3–4 m). Unfortunately, all the species could not definitely be identified because of fragmentation, but it is obvious that there are bone remains of animals that were markedly different in size. Besides nondiagnostic bones, some axial fragments of cervicus vertebrae were collected that undoubtedly belonged to a mammoth (identification by A. K. Kasparov, Institute for the History of Material Culture). The composition of species represented only by fragmented bones and the specific character of the fragmentation make it possible to assume that the assemblage appeared as a result of human activity. Some specimens were collected beyond the stratigraphic horizon containing the pieces of bone. The carbon dates obtained for the latter—10,020 ± 80 (LU-3152) and 9680 ± 130 (LU-3153)—to my mind, could be considered an additional argument supporting the idea of the artificial origin of a complex that occurred near the Pleistocene-Holcene boundary—being contemporaneous with the most favorable period of the Holocene climatic optimum. The latter is dated in the Asian Arctic from 9000 to 10,000 BP, which has been repeatedly confirmed by research in the high Arctic—on the North Land and New Siberian archipelagoes, and in continental polar territories as well (Makeyev et al. 1979, 1989; Tomskaya 1989; Boyarskaya et al. 1989; Kaplina and Lozhkin 1982; and others).

However, if the peopling of the northeastern Europe and, to some extent, the populating of northwestern Siberia and the Taimyr Peninsula, depended primarily on regional trends of glaciation, the Late Pleistocene geography and environment affected that process in the East Siberian Arctic, while American Polar Regions were partially of another character. It is generally known that, due to the expansion of the North European and Laurentide ice sheets, a large (at least 90–100 m, or even more according to some authors) drop in sea level occurred and vast territories of polar shelf were exposed. That great Arctic plain extended from the Taimyr Peninsula to the Bering Strait area and up to 76°N, including the locations of the New Siberian archipelago and Wrangel Island. That plain, as well as the adjacent area of the Bering Land Bridge, was submerged by the Holocene transgression of the Arctic Ocean, but during the period under consideration it was a giant ecological niche providing unlimited food sources. Although the area had rigorous conditions it was undoubtedly populated, or at least visited continually, in its eastern part adjacent to the Bering isthmus. However, persistent archaeological research carried out in the nearest locations that are relicts of the Land Bridge—in Alaska and on the Chukchi Peninsula—have yet to discover indisputable materials that can be dated earlier than 11,000 BP (Powers et al. 1990; Pitul'ko 1992; Dikov 1993). Maybe that is because these materials never existed here, and the migrants—as, for instance, Alexander Easton (1992:28–36) supposed—moved along the south shore of the Bering Bridge.

But there is no doubt that the Siberian Arctic was populated as far back as the Late Pleistocene. The data lighting these earliest stages of peopling are still rather sparse and are worked out from the findings coming from a few places explored by Yu. A. Mochanov and his collaborators on the North Siberian coastal lowland (Mochanov 1977; Argunov 1990; Scherbakova 1980). However, these materials are primarily nondiagnostic or are associated with artifacts that are distinctly younger, or are represented through Pleistocene faunal remains that, as it was the case with the Engelgardt Lake complex on Taimyr Peninsula, could only be considered the result of human activity. The latter could be applied to assemblages from Adycha (Mochanov 1972:252; Scherbakova 1980:65), Bochanut (Mochanov 1977:93), and Kigilyakh (Mochanov and Fedoseyeva 1980: Map 247, and personnel communication), where only the fragmented bones of Pleistocene animals were found. In fact, only one site providing real archaeological data has been discovered. This is the famous Berelekh site, carbon dated repeatedly to 12,000–13,000 BP (Vereschagin, Mochanov 1972:332–336; Mochanov 1977:76–86), although an additional series of carbon dates published recently by N.K. Vereschagin and V.V. Ukraintseva (1985) shows that it could probably be dated somewhat later—about 10,000–11,000 BP. The northernmost Final Pleistocene site marking the border of the Paleolithic ecumene shows that the continental Arctic area was populated up to at least 71°N during that period. In this connection, it is interesting to note artifacts discovered in the core of Hole 19 drilled near Kymynyikei Mount, which is located in the southeastern part of the Vankarem shore depression. The hole pierced a succession of three morainic strata interlaid by some intermorainal deposits. The core sample, containing artifacts (five flakes and a wedge-shaped core), was lifted from a depth of 32–33 m, where boulder-pebble loam comprising the deposits of the third (earliest) moraine was found (Laukhin et al. 1989:136–140). The unexpected origin of the material and the typological peculiarities of the wedge-shaped core, which is believed to be similar to cores from the Ikhine II and

Ust-Mil sites (on the Aldan River in Yakutiya), enable researchers who base their ideas on the chronology of Aldan Paleolithic sites advanced by Mochanov (1977), to date the Kymynyikei artifacts to about 30,000 BP. At the same time, the opinion by Z.A. Abramova is well known, who supposed the age of ancient Aldan sites to be much later, about 18,000 BP (Abramova 1979). Although I am not inclined to share that view and would not like to disprove the Sartan age of the moraines found near Kymynyikei Mount, I presume that the bases used for dating of the assemblage are not secure since there are no dated carbon samples from Hole 19. In my view, to discuss the problem precisely we at least need the earliest date established with certainty, but for the present these materials need to be listed with other unusual facts.

Evidently the populated area of the Arctic, and just the Asian one, expanded greatly during the Early Holocene. Data characterizing that period are rather scanty. However, there are about 30 or 40 sites in the territory extending from the Taimyr Peninsula to the Chukchi Peninsula. The discovered assemblages have a Mesolithic typology and are dated to the first half of the Holocene. This could probably be explained by the increasing mobility of hunting groups (Krupnik 1989) forced to change hunting specialization; the favorable conditions of the Holocene optimum and the northward shift of the landscape zones favored migrations to the north and the populating of high Arctic territories (Makeyev and Pitul'ko 1991). The Mesolithic site excavated on the Zhokhov island in the De Long archipelago at 76°N in 1989 and 1990 (Pitul'ko and Makeyev 1991, Pitul'ko 1993) belongs exactly to that period. Repeatedly carbon dated to 8000 BP, the site is undoubtedly the earliest known evidence of human migrations into the high Arctic (see Chapter III). At the same time, judging by the sparse notes of Matvey Gedenshtrom and Yakov Sannikov (Gedenshtrom 1822), sites similar to the Zhokhov settlement might be common for the New Siberian Islands, which were a relic of the presently extinct Late Pleistocene Arctic plain. One can assume that the Early Holocene assemblages from the East Siberian trans-polar areas are similar and not infrequently guessed to be components of a general cultural phenomenon spread from the Taimyr to the Chukchi Peninsula (Mochanov 1977; Argunov 1990; and others).

In general, it can be noted that human occupation of Arctic regions occurred rapidly, though the density of the population remained minimal. It is most likely that all of the available territories were occupied during each stage of the process, as was the case with the eastern Arctic, where Mesolithic hunters moved northward to 76°N about 8000 BP. Another distinct example can be found in the Canadian Arctic and Greenland, where Paleo-Eskimo sites appeared about 4000–4500 BP, immediately after deglaciation of lowlands and islands. The finds of Eigel Knuth (1962) in Peary Land at 82°N show that the tendency to occupy all of the available territories occurred at that time too.

# CHAPTER III
# The Zhokhov Island Mesolithic Site

## 3.1. Geography, Palaeoenvironment, and Quaternary Deposits

The De Long Islands, located between 75° and 76°N and from 148°50' to 159°E, are the northernmost part of the New Siberian Islands. This group consists of five small, isolated islands. From Anzhu Island, the main part of the archipelago, the closest island to the group—Vil'kitsky Island—is approximately 60 km, and the farthest—Jeannette Island—is some 200 km. Three of them—Jeannette, Henrietta, and Bennett Islands—were discovered in 1881 during a polar expedition led by George Washington De Long, a U.S. Navy officer. Two others—Vil'kitsky and Zhokhov Islands—were put on the map in a Russian expedition led by Boris Vil'kitsky in 1913–1915 on the icebreakers *Taimyr* and *Vaygach*. For the past 80 years the islands have been rarely visited. The weather station established on Henrietta Island in the 1930s lasted until 1963. Another one, established in 1955 on Zhokhov Island, was closed, as was the logistics camp of the Arctic and Antarctic Research Institute (AARI), in September 1993. The De Long Islands, which have a total area of only about 300 km$^2$, were closed for decades to non-Soviet scientists, and little has previously been written about them outside Russia.

The polar geography department of the Arctic and Antarctic Research Institute in St. Petersburg conducted an interdisciplinary research project in 1987, 1989, and 1990 on two of the islands of the archipelago—Bennett Island and Zhokhov Island. The program considered many aspects of the Late Quaternary period of the region, particularly glaciology, geomorphology, palaeoenvironment, and the problems of early human occupation of this area of the high Arctic (Verkulich et al. 1989; Verkulich, Krusanov, and Anisimov 1990; Makeyev and Pitul'ko 1991; Makeyev, Pitul'ko, and Kasparov 1992ab; Pitul'ko 1993; and others).

The modern environment of the archipelago is that of a typical polar desert, unfavorable for most species of land flora and fauna and providing poor facilities for human survival. Illustrative of this point are several parameters of the environment. For example, at the weather station on Zhokhov Island, the July mean temperature varies from +0.5 to +1.0°C (32.9 to 33.8°F), while that in January is -28 to -30°C (-18.4 to -22°F). The average annual precipitation approaches 135 mm (8.24 inches).

The ice cover is extensive on Henrietta and Bennett Islands, covering almost 60% of the former and approximately 44% of the latter (Koryakin 1988:97, 98). According to Verkulich and others (190:111–115), there are four major glaciers on Bennett Island: the Toll (55 km$^2$), the East De Long (5.15 km$^2$), and the West De Long (1.17 km$^2$) glaciers, and the Maly ice dome (4.04 km$^2$).

The vegetation on the islands is sparse; only 30 different species of flowering plants are known to exist in the entire archipelago, while it is observed that the moss and lichen flora are rather diverse. Similarly, there is not a wide variety of mammalian life, which consists mainly of polar bears, foxes, and sea mammals (notably ringed seals, occasionally bearded seals and walrus). The walrus of the Laptev Sea area are believed to differ from the Atlantic (*Odobenus rosmarus rosmarus*) and Pacific (*Odobenus rosmarus divergens*) subspecies, and Chapsky (1940) tentatively describes them as a separate subspecies: *Odobenus rosmarus laptevi.* However, the remaining animals in this group, whose natural habitat extends from the east coast of the Taimyr Peninsula to the De Long Islands area, are generally regarded by taxonomists as *Odobenus rosmarus rosmarus* because of craniological similarities. Reindeer are no longer found in the De Long Islands, although Edward Toll' and his companions reported seeing them on Bennett Island in 1902. Many birds migrate to the De Long Islands in the spring and remain until early autumn.

Since the fundament of most of the islands consists of similar Cretaceous alkali igneous rock formations (in addition, Palaeozoic sedimentary rocks were found on Bennett Island), the islands are similar to each other in topography, appearing as plateau-like surfaces elevated 200 to 400 m above sea level and bounded by steep cliffs. Zhokhov Island is an exception, with a Pleistocene low-lying plain in the southwestern and eastern sections and uplands in the central part. The thin cover of Quaternary sediments overlying bedrock has been surveyed on each island. These sediments are best studied on the largest islands of the archipelago—Bennett Island and Zhokhov Island—where they cover the most extensive areas. There are marine, lacustrine, bog, slope, glacial, and icy loess loam ("yedoma" type) deposits. This composition is assembled as channel sediments in creek and river valleys. Severe permafrost conditions are present in these areas and the fine-grained deposits are often broken by epigenetic polygonal ice veins of several generations, whose thickness can be about 5–7 m and width 3 or 4 m. The average size of the active horizon thickness is about 20 cm.

Marine deposits have been discovered on some marine-cut terrace levels: at elevations 2.5–3 m (I), 8–12 m (II), 25–40 m (III), and 50–70 m (IV) on Zhokhov Island, and at 4–5 m (I), 7–10 m (II), 40–50 m (III), 80–100 m (IV) on Bennett Island. The terraces are primarily bedrock. Marine sediments are not thick as a rule, and in a number of cases they look simply like pebbled surfaces, but sometimes the thickness can be much greater. Thus it could reach about 25 m in buried valleys, where a composition of sand and aleurite deposits, pebble gravels, and boulder sediments have been discovered associated with marine mollusk fauna (foraminifera, ostracodes, and sponges) and fossil pollen associations coming from some layers. At present there are only two levels (the $1^{st}$ and $3^{rd}$), dated respectively to 4000–5000 BP ($1^{st}$) and 300,000–350,000 BP ($3^{rd}$). The $2^{nd}$ terrace is most likely of Kazantsevo age inasmuch as exposed deposits are dated from 29,830 ± 780 (LU-2027) to >40,850 BP, LU-2146 (Makeyev, Pitul'ko, and Kasparov 1992:271, 272).

Drift sediments are represented generally by diverse morainic deposits of ablation, bottom, or rarely, end moraines. There are no fluvioglacial deposits on the islands. The latter probably disappeared due to transgression, being located on submerged lowlands, or eroded and buried by channel deposits in erosional valleys. Moraines located on watersheds are usually represented as single transported boulders and blocks, or as sections with a boulder surface; boulder-loam soils are found on nearby slopes or in topographic depressions. End moraine deposits (boulders, pebbles, and stone blocks with lenses of boulder-pebble-loam soil and sand lenses) have a clear topographic occurrence, being represented by low hills and morainal ridges that sometimes comprise chain structures 400 m long and 50 m wide.

Drift accumulations are believed to have been deposited during two glacial periods, and it is recognized that the most extensive sediments of the earlier one are of the Zyryan glaciation (Makeyev, Pitul'ko, and Kasparov 1992). The recent one, recognized as the Sartan, covered the Bennett Island area almost completely (Verkulich et al. 1989) but was restricted to the central upland on Zhokhov Island, where small glaciers were of both the cirque and slope kinds. According to radiocarbon dates, the last glaciation of the De Long Islands ended at the very conclusion of the Pleistocene. Carbon dates of 12,590 ± 60 BP (LU-2096), obtained from mammoth ivory on Bennett Island (Verkulich et al. 1989), and of 10,960 ± 310 BP (LU-2516), obtained from peat extracted from the banks overlying Sartan moraine deposits on Zhokhov Island, indicate that the local ice sheets had disappeared or were minimal during this period (Makeyev and Pitul'ko 1991).

Both the slope deposits covering the eastern section of Bennett Island and the icy loess accumulations in the southern and eastern sections of Zhokhov Island contain numerous bone remains of fossil faunal species (mammoth, bison, horse). The former are dated to 30,000–29,000 BP and associated with pollen from a predominance of herbaceous floral species (wormwood, cereal plants, and sedge), indicating a rigorous continental climate characteristic of this interval and the tundra-steppe landscapes that occupied the area. They are similar to pollen obtained from loess sediments on Zhokhov Island—although the latter are from a somewhat later period—and are extremely close to pollen associations coming from nonglacial deposits of Sartan age studied on Kotelny Island (Makeyev et al. 1989; Makeyev, Pitul'ko, and Kasparov 1992). All these data show that the mammoth faunal assemblage successfully survived even during the Sartan glacial. But probably some species, such as bison and horses, were already absent.

Boggy lake sediments, widespread on Zhokhov Island in particular, are of special interest. In general, they can be found overlying the rest of the Quaternary accumulations except the most recent sediments or re-depositions. This stratum is composed of well-bedded aleurite and loamy soil with strong ice content and peat (or organic detritus) interlayers. The observed thickness of these sediments does not exceed 3 m. The floral species and pollen frequencies obtained from the column sequences vary markedly.

The Early Holocene deposits, dated in the interval from 11,000 to 7800 BP, are characterized by pollen complexes with herbs predominating (the absolute pollen frequency varying from 60 to 90% in some horizons); cereal plants and sedge represent the greatest part of the composition, although species of wormwood (*Artemisia*), pinks (*Dianthus*), and valerians (*Valeriana*) have peak concentrations in some beds. The pollen content of arborescent vegetation generally fluctuates from 5 to 16%, while spore grains range from 3 to 30%. The layer, dated from 9500 to 8700 BP, is composed of moss-and-grass peat containing willow macro fossils (twigs and leaves). The absolute pollen content of the arborescent group rises sharply, up to 30%. The arborescent composition includes *Betula* sect. *Fruticosae* (36%), *Alnaster* (18%), and *Salix* species 17%. Cereals (*Cyperaceae*) predominate among herbs, while spore grains are only 5–7%.

Pollen associations dated from 8020 to 7800 BP are somewhat different. Herbs and dwarf-shrubs absolutely predominate, their content rising up to 74–87% (cereals up to 39%, pinks up to 20%, valerians up to 28%, and wormwoods up to 9%). Unlike the former horizon, the absolute pollen content of arborescent plants decreases strongly down to 5%; spore grain frequency is at the same level—about 5–7%. In summary, the pollen assemblage characteristic for the interval 8020 to 7800 BP shows that typical polar tundra landscapes existed on Zhokhov Island contemporaneously with the Zhokhov Island Mesolithic sites, and was the natural environment of the early high Arctic natives.

All of the available data make it possible to consider the next succession of the regional climatic-environmental changes in the Late Pleistocene-Holocene.

The continental-type climate of the De Long archipelago area was stable during the major part of the Late Pleistocene, as far back as the post Kazantsev and later. From this time until the Middle Holocene, sea level was significantly below that of the present day. The Arctic Ocean reached its maximal regressive phase 20,000 to 18,000 BP, corresponding with the cold Sartan thermal maximum, and an extensive area of shelf zone (up to 100–120 m depth) was exposed. The shorelines were shifted farther northward, and in the De Long area the shoreline was located somewhere at the latitude of Bennett Island. The New Siberian Islands and, to some degree, the coastal Kolyma and Yano-Indigirskaya lowlands are relics of this Arctic land. The expanded flatland that appeared was an additional factor affecting the climate, which became more continental. The global cold temperature trend that took place in the Late Pleistocene was less important because of the moderating of the regional one. Glaciation occurred twice in that period, but both glacials were rather small in range and did not affect the environment in the least. Later, a warm global climatic trend distinctly occurred in the region.

The climate of the New Siberian region was warmer than the current one during most of the Holocene; the interval from 10,000 to 8500 BP was especially warm. The latter is considered the Holocene climatic optimum of the Siberian Arctic, which is attested to by the correlations with paleogeographical data obtained on the high Arctic islands (Verkulich et al. 1989; Makeyev et al. 1979, 1989; Makeyev and Pitul'ko 1992). Contemporaneous with the Flandrean transgression maximum, which took place about 4000 to 4500 BP, the climate of the New Siberian region was transformed into a marine Arctic type. Climatic conditions remained stable up to the Late Holocene, but some fluctuations are recognized: rises in temperature occurred in 7500, 5000, and 2500 to 2000 BP. Analogous data on climatic changes in the New Siberian Islands area have been obtained from the profile sections of Kotelny Island (Makeyev and Ponomaryeva 1988).

The great Arctic plain was submerged or eroded by the Late Pleistocene-Holocene transgression of the Arctic Ocean, but extensive relic sections existed as recently as 8000 BP. The rate of transgression was irregular throughout the Arctic, owing to the direction and intensity of tectonic movements and glacio-isostatic effects (Ivanov and Makeyev 1987). Transgression was dynamic and reached the maximum about 4000 BP, remaining for a while above the current sea level. The formation of the New Siberian Island chain most likely ended at that time.

Available data (Degtyarenko et al. 1982) provide a poor background for considering the dynamics of this process. Sea-level fluctuations resulted in the development between 8000 and 9000 BP of a sea level 20 to 25 m below the current one in the New Siberian region. That the mean depths (at the shelf) of the Laptev Sea and the East Siberian Sea are generally not more than 20 m indicates that most of the New Siberian Islands as far north as Vil'kitsky Island were a peripheral flatland joining the mainland and are an extensive relic of Arctic land—the "New Siberian Peninsula" (Figure 2)—which was easily accessible for hunting groups penetrating polar areas at least to 71°N as far back as 13,000 BP. It is not quite clear whether Zhokhov Island was part of the "peninsula." Vil'kitsky and Zhokhov Islands were probably separated by a narrow sound 5 to 8 km wide; even if Zhokhov Island was an island, it was still considerably larger than today.

However, it is obvious that some part of the shoreline was located near the current Zhokhov Island in about 8000 BP, which is indicated by the excavated materials: an abundance of driftwood and artifacts made of that material were found as well as the numerous polar bear bones and isolated bones of sea mammals.

## 3.2. A Story of Research, Site Location, Stratigraphy of the Site, and Dating

It can easily be seen that islands of the De Long archipelago are a rather remote, isolated area that is difficult to reach. They are completely deserted now. Weather stations were established on some islands, which were therefore permanently inhabited. A station existed on Henrietta Island from the mid-1930s to 1963; another was established in 1955 on the southeastern part of Zhokhov Island. (It was moved to the northeastern extremity of the island at the very beginning of the 1970s, and closed, along with the AARI logistic camp, in 1993.)

In summer 1967 I. Ye. Zhidkov, a mechanic operator from the Zhokhov weather station, and a telegrapher from the crew of the vessel *Indigirka* whose name remains unknown, gathered a few artifacts in the southwestern part of Zhokhov Island. A major portion of the artifacts was later lost, but two large tools resembling picks or mattocks made of mammoth ivory were brought by chance to the Leningrad Branch of the Institute of Archaeology (now the Institute for Material Culture History in St. Petersburg) at the beginning of the 1970s; they were reported as surface finds discovered somewhere on Zhokhov Island. Because of fluvial abrasion, the artifacts had smoothed surfaces; it was impossible to advance an idea about how they were processed or, even more, to date them precisely inasmuch as tools of that kind are known from recent Eskimo sites. Taking into account both the first and the second, L.P. Khlobystin, who examined the finds, has advanced a correct but relative interpretation by considering them to be from the Iron Age. Applied to the absolute chronology of Arctic sites, this means within the last

2000 or 2500 years. In exactly that way of interpreting, the finds were put on the archaeological map of the Arctic (*The Arctic Atlas* 1985:Map 20). Although on the map, "scientific discovery" of the site took place about 20 years later. Verbal information about the site circulated among the personnel of the polar stations located on the New Siberian Islands and was collected by palaeogeographer V.M. Makeyev while surveying the southern area of the archipelago in the late 1970s to mid-1980s. Once the exact site location was identified it became possible to survey it, and S.A. Kessel, leading the Zhokhov logistics camp of AARI in 1985–1986, collected some surface finds. The collection, brought to Leningrad (St. Petersburg), was composed of fragmented bones, antlers, and wooden pieces with good preservation, some of them split or with cut marks. Because of that, the material was thought to be rather recent, but the first carbon date obtained from a wood sample was surprisingly ancient (more than 8000 BP). These facts were reported by Khlobystin at the Arctic Meeting in Honor of the 200th Anniversary of Arctic Archaeological Research, which was held in Leningrad in the spring of 1987. However, the report (Khlobystin 1990) appeared when the first results of the excavations were published. I had a chance to excavate the site twice, in 1989 and 1990. The excavations were supported by the Arctic and Antarctic Research Institute as part of the interdisciplinary project conducted on the De Long archipelago in 1987, 1989, and 1990. The field seasons were rather long, occupying five months in 1989 and about four in 1990, although the excavations were significantly shorter—about six and eight weeks respectively.

Zhokhov Island is one of the five islands in the De Long group, which along with the Anzhu and Lyakhovskiye groups comprise the New Siberian Islands. It is situated at 76°N. The island is small; the greatest distance from north to south is about 11 km, from west to east approximately 9 km. The central section of the island is of upland topography, with isolated isometric or ridged hills formed mostly by effusive basalt; the highest elevation is approximately 125 m above sea level. One of the isolated hills, in the southwestern part of the island, has an elevation of 115 m. The Zhokhov Island site is located near this hill (Figure 1:2). A low-lying littoral plain, flat and sloping to the sea, occupies the rest of the island. This plain is probably a remnant surface of the ancient abrading-accumulating terrace of the Pleistocene sea. Its elevation is between 20 and 40 m. The plain's surface is intensively dissected by small, shallow thermokarst depressions and by a system of erosion valleys radiating from the center of the island. The valleys are cut 15 to 20 m in depth; a major part of them have small intermittent rivers or creeks.

A sequence of marine terraces has been distinguished not far from the modern shoreline (see above). They are present in a number of places, including the territory near the site. The two lower ones were most likely formed during the second half of the Holocene. As mentioned earlier, all of the terraces are cut into pre-Quaternary bedrock, commonly basalt. The bedrock is exposed on the surface of the modern terrace in some locations on the west side of the island. Here and there the bedrock is overlain by a thin cover of slope deposits. The cover of Quaternary sediments composed of marine, lake bog, and alluvial deposits (sand, sandy and loamy soils, pebbles, and peats) has a greater thickness in the southwestern, southern, and southeastern sections of the island, including the site location. These areas have severe permafrost conditions, and the deposits are often broken by several generations of epigenetic polygonal ice veins. As a result of thermokarst and other cryogenic processes, karst and pingo-like mesorelief is widespread on the slopes of the river and creek valleys. Since this type of mesorelief is rarely found on valley-side slopes, it is a distinctive feature of this terrain.

The vegetation is sparse on the site and on the island as a whole as well as on other islands of the De Long archipelago. Typical polar floral associations are found on Zhokhov Island; they include mosses, lichens, diverse grasses, and shrubs common to impoverished Arctic tundras.

The site location is east of a small creek valley that crosses the littoral plain not far from the foot of an isolated hill (Figures 1:2; 1:3; 3). In selecting this site, the ancient inhabitants probably took into account some or all of the following factors: (1) the presence of a fresh water spring; (2) the hill might be used as an observation post, or (3) it might provide protection from extreme weather, especially the strong north wind; and (4) the area was naturally well drained. The site today is not far from the beach—about 1 km. While the previous position of the coastline is uncertain, the beach or a lagoon must have been near enough to provide the source of the great quantity of split driftwood used by inhabitants of the site.

The area of the site is about 8,000 $m^2$ and ranges in elevation from 13 to 20 m above sea level (Figure 1:3). Surface finds are discovered sporadically in this area, but sometimes fragmented bones and pieces of split driftwood, having been pushed to the surface by cryogenic processes, form accumulations within the thermokarst hollows (Figure 4) or in the center of certain shallow round pits (Figures 5, 6). Thirteen such features were found, some of which could probably be dwellings. The cultural layer on the largest part of the site is most probably discontinuous, with material being concentrated around the dwellings (?).I judge that the high part of the site was intensively used. One such location is a cape-like projection turning into the creek valley on the highest part of the site (Figure 7). This area was subjected to intensive destruction from erosional processes and solifluction. Features numbered 1, 2, and 3 are on this "cape" (Figure 1:3). They seem to be dwellings disturbed by solifluction. Feature 1 is a disordered accumulation of bones and large pieces on the cape extremity. Features 2 and 3, on the west slope of the cape, are also disturbed as well as Feature 4, which is exposed in a thermokarst depression (Figure 1:3). The intact portions were excavated.

The excavations were carried on in accordance with methods generally practiced, except for the determination of elevation for each find (only wooden pieces were vertically determined); the latter seems to be senseless for this site because of the peculiarities of a permafrost-affected cultural layer. Though the materials dug out had never been redeposited, none of the artifacts was unquestionably found in its original position. A lot of information was revealed concerning the permafrost-affected orientation or position of the artifacts; thus the small ones "float" in the permafrost horizon. Unfortunately, it was impossible to manage screening or washing the matrix. Excavations in permafrost horizons are site-specific because of excess moisture in the soils owing to melting of dispersed ice, ice veins, etc. Therefore it is sometimes necessary to make artificial drainage for the dig, and areas naturally sloping with an angle of 3° to 5° are the most usable for excavations for obvious reasons. The experience of the Zhokhov excavations shows that the best digging strategy that could be applied by a small team of four members (under the condition that the project was supposed to be of about a two-month duration) was to open 70 to 80 $m^2$ simultaneously, to a depth of the top of permafrost layer, i.e., the active horizon needed to be dug out. After that, it became possible to excavate in succession the areas that had thawed out (the normal depth of thawing was commonly about 2 to 3 cm per day), but for excavations to start, the thawed areas needed to be drained and dried, which takes 1 to 3 days (Figure 8). The excavation of areas saturated with wooden pieces, where slowly melting lenses of solid ice are concentrated (Figure 9), is most complex owing to the heat resistance of the latter. The slowly melting lenses promote constant surplus moisture in the layer and conservation of a low surface temperature (about 0°C). Excavation was relatively easier on the sloping, well-drained sections, such as 1–8, dug out in 1989, and 24 and 25 in the 1990 dig; these were located on a steep slope of the cape (Figures 10, 11). In contrast, excavations on flat areas were extremely difficult, especially when they were saturated with wooden pieces and fossil ice. However, we succeeded in excavating 144 $m^2$ during two field seasons in 1989 and 1990, including an area of approximately 20 $m^2$ in Sections 31–36 covered by a thermokarst depression (Figures 11, 13, 14).

The area excavated in 1989 (Figure 12) was put on the general excavation grid, with continuing research in 1990, and the west section, between grid lines 3 and 7, was excavated first. This section was chosen because it was supposed that (1) the cultural layer covering the flat cape surface was thought to be relatively undamaged by cryogenic processes, and that (2) the section of the cultural layer exposed on the northwest side of the thermokarst depression (Sections 26–28, 32, 33) was extremely attractive for excavations, being saturated with wooden pieces, antlers, and fragmented bones (Figures 5, 15, 16). Later, the excavation was extended to the east of the thermokarst depression. The latter, in fact a separate dig, was named the east section.

Our excavations revealed stratification as presented below. Through precise observations, some stratigraphic differences were recognized between the west and east sections of the dig, but they are of little importance. The stratigraphy of the west section is similar to a column already published (Pitul'ko 1993).

Inasmuch as the deposits lying in the direction of Line C are of greater thickness, but still remain in the original position, the cross section done from point C1 to C5 can be considered the reference (Figures 18, 19, 20). The sequence is as follows:

| | |
|---|---|
| 1. Turf cover (often broken). | 3–5 cm |
| 2. Modern grey-brown light loamy soil, vaguely bedded and saturated with crumbled stones of a local sort, dense, and rarely pebbles and gravel.[1] | 3–25 cm |
| 3. Icy peat moss, fragmented and exfoliating, brown or dark-brown, or almost black in color, containing small bone fragments, wood pieces, and single flints; a contact zone with both overlying and underlying horizons (especially with the latter) is characteristic.[2] | thickness varies from 1–2 to 15–20 cm |

| | |
|---|---|
| 4. Ice-cemented bright-brown loamy soil, well frozen and containing artifacts, faunal remains, wood, charcoal (cultural layer); ice is in interbeds, clusters, and lenses; the latter are 4 to 5 cm thick and especially numerous in wood accumulations; ice contains gas bubbles and has flinty fractures; the total ice content is 50 to 70%; both contacts are embayed. | thickness varies from 8–10 to 30–40 cm |
| 5. Bedded composition of dense gravel with an admixture of sand, crumbled rocks, pebbles, and small boulders, and with ice interbedding;[3] bedding is flat, flat-dipping, or inclined and could be observed especially clearly after the melting of the ice interbeddings and lenses; the latter are 1 to 5 cm thick; the total ice content is about 60%; dense gravel and crumbled stones (tuff rocks), primarily red-brown in color, are poorly water-rolled; the thawed layer is of the same color (channel deposits). | 15–30 cm |
| 6. Blue-grey hard loamy soil, dense and containing a quantity of pebbles; small (2 to 5 cm) compact lenses of black-brown paper peat (rolls from eroded sediments?); the layer of high ice content has a thick-bedded texture (wavy, fine bedded in spacing).[4] | thickness was not defined |

Notes

[1] The thickness of the active horizon does not exceed 20 cm at the site. All of the deposits are in permafrost conditions beginning approximately from this level and saturated with veins of ice (cluster ice, ice lenses, and interbeddings). Discovered there were three generations of polygonal ice veins ranging in thickness of centimeters, decimeters, and meters, which are superposed.

[2] Found discontinuously in the West section of the dig, with varying thickness. The layer is of recent age and carbon dated to 2200 ± 30 (LU-2435). Peat accumulated in some extended thermokarst depressions during the last series of warm Holocene periods, pointed out by Makeyev and D.P. Ponomaryeva (1988). The peat layer contains individual artifacts and faunal remains, but by no means can these be considered evidence of recent occupation of the site since they are connected with the commonly observed normal migration process of some objects in permafrost soils. Besides, the artifacts might have been introduced into the peat layer as the result of the kettle cut into a cultural layer. Permafrost affecting the position of artifacts can be seen easily from the position of elongated artifacts or, more often, wood pieces that as a rule are found in a more or less vertical position.

[3] Lenses of the same composition were found while excavating a cultural layer.

[4] Only the upper part of that layer was exposed in the cross section C1–C5. Its genesis is unclear. However, analogous deposits have been described in a major part of the New Siberian Islands and, according to some researchers, indicate a surface drained by the Sartan regression of the Arctic Ocean (Sisko 1970:422–453). Peat sampled from the top level of the stratum was dated to 8790 ± 90 (LU-2502). This provides the earliest date for the site.

The succession described in cross section C is typical for the entire west section of the dig. We found that the cultural layer was disturbed more or less substantially, or almost completely gone, owing to sliding in Sections 9, 10, 13–15, 17–21, and 30. Drawing this conclusion, I take into account observations made while excavating Sections 11, 16, 22, and 29 and the character of the distribution of the finds. The clear thinning of the cultural layer was discovered in the direction toward Line 3 and Line D (Figure 13). Also, the cultural layer excavated in Section 25 was not in its original position. The latter probably contained artifacts transported from adjacent elevated sections. The few finds discovered in Section 26 were obviously washed from the thermokarst depression.

A surface exposure of the cultural layer, observed along the northwestern side of the thermokarst depression (Sections 27, 28, 31–33), appeared owing to the sliding of a number of soil blocks comprising the upper part of the cultural layer and covering deposits. Perhaps a part of the solimixtion was secondarily sod-covered.

In this way it can be concluded that the cultural layer remained relatively undisturbed in Sections 1–3, 8, 12, 23, and 24 (Figure 13). The maximal thickness of the alluvial deposits, which contained very few artifacts introduced to a rather deep level of the stratum, was discovered precisely in that area. Wood pieces were found in great abundance in these and adjacent sections: in 16 and 22—in the area along Line D and in Sections 27 and 28 (Figures 12, 15, 16). The dimensional diversity of the fragmented wood deserves attention. As a rule, there were relatively small wood pieces and slivers, but a considerable quantity of large posts were found too. Both the former and the latter have clear traces of artificial splitting or other processing marks. Many of those excavated were in a vertical position. Still it is doubtful whether these are the remains of dwelling structures inasmuch as this position of wood fragments, as well as elongated artifacts that turn up, can be affected by the natural life of the permafrost layer, expulsion processes, etc. It is difficult to find regularity in the distribution of the wood pieces, but apparently a structure was discovered in Sections 12 and 16 near Line C, bounding them, where some overlapping wooden blocks provided the most productive spot for the cultural layer (Figure 16). Perhaps they can be interpreted as the remains of a roof or wall structure. A similar composition of large wooden blocks is also observed in Sections 1 and 2, excavated in 1989 (Figures 12, 21).

As mentioned above, and what is absolutely obvious from the description of cross section C, all of the excavated deposits are ice-cemented with the ice content often rising to 60–70%. Besides, three generations of polygonal ice veins were discovered ranging in thickness of centimeters, decimeters, and meters, and superimposed. The strata are saturated with segregated ice of different sorts (cluster ice, ice lenses, and interbeddings) making up the ice veins. Owing to the destruction of the strong, three-meter-thick ice vein exposed in Sections 31, 40, and 43, a thermokarst depression occurred sometime at the most elevated area of the site, now covering the central part of the excavation grid (Figure 1:3; 11). A rounded, circular slide depression has a bottom overlaid by a thin cover of wet loamy soil containing few small wood pieces and bone fragments. Its entry, open to the creek valley, was overlapped partly by dump soil left by some amateur excavations about 20 to 25 years ago; the dump had a secondary turf-like crust composed of lichens and mosses. A few insignificant artifacts were found there. The solimixtion covering of the slide slopes of the depression was excavated as well as an undisturbed area.

As for the depression, the most significant results were obtained while excavating Sections 41 and 42, adjacent to the east area of the dig and covering the southeastern slope (Figure 24). The latter is located almost along the Line E10–D10, where posts and large wooden blocks resembling a roof structure or planking were observed in 1989 (Figure 6; Pitul'ko 1990, Field Report: Figs. 25, 26). Surprisingly, nothing connected with the latter was found when excavating Sections 41 and 42 or the adjacent Section 50 (Figure 17).

It was recognized that a considerable part of Section 41 serves as a trap for sediments containing cultural remains, which were accumulated in the accretion vein stretched in the direction from F9 to E10, i.e., along the diagonal of the section. All the pieces found in that vein accumulation are laid out within the limits of a narrow strip 30 to 50 cm wide (Figure 14). Outside these limits the cultural layer is in the original position. Because of the great thickness of deposits, the second reference profile was done from point F10 to point E10 (Figure 24). The stratigraphic succession described for the latter differs slightly from the sequence found in the C1–C5 (west) profile, but it is typical of the east area of the dig, at least with respect to the upper levels. The ice underlying the profile does not extend continuously in the entire east area of the dig; normally there is a horizon of heavy gray-blue loamy soil at the base of the sequence. It is obvious that the major difference between the west and east stratigraphic sequences is the absence of a peat layer in the latter, while other differences are less important. However, the horizon does not have a uniform thickness and has a discontinuous extent even in the west dig area; the maximal thickness of the peat layer was observed in Sections 8, 12, and 25.

The East reference section is as follows:

| | |
|---|---|
| 1. Turf cover (often broken). | 0–3 cm |
| 2. Modern grey (with blue tint) heavy sandy soil, fractured; contains grass roots in fractures, and single crumbled stones of local sort, large in size. | 13–15 cm |
| 3. Ice-cemented gray (with blue tint) light, clumpy loamy soil, well frozen and containing artifacts, faunal remains, wood, charcoal, hide pieces of hair, dog excrement (cultural layer) as well as peat portions, crumbled stones, pebbles, and cobbles; the lower part of the stratum is poorly bedded due to alternation of extremely thin beds of pure loamy soil saturated with organic detritus; the upper contact is embayed. | 37–40 cm |
| 4. Ice-cemented coarse sand with an admixture of gravel, crumbled rocks, pebbles, and small boulders; lenticular interbedded; lenses consisting of beige sandy soil are 1 to 2 cm thick and contain fragments of wood and plant detritus; a few pieces of bone and wood were found, one of the latter dating to 8020 ± 50 BP; detritus, gravel, and crumbled stones (tuff), mainly red-brown in color, are poorly water-rolled; the thawed layer is of the same color (channel deposits). | 25 cm |
| 5. Ice horizon, replaced in the rest of the excavated area by blue-gray hard loamy soil, containing some quantity of pebbles and detritus, and small (2 to 5 cm) compact lenses of black-brown paper peat (rolls from eroded sediments?); the layer of high ice content has a thick-bedded texture (wavy, fine-bedded in spacing). | thickness was not defined |

All the deposits except the active horizon are ice-cemented with the total ice content varying from 50 to 70%, and saturated with separated ice found as interbeds, clusters, and lenses—the latter 4 to 5 cm thick—and especially numerous inclusions of wood; the ice contains gas bubbles and has a flinty fracture. The entire stratum has a thin interbedded texture as a rule, while thick interbedding is rare.

The finds excavated from Section 41 were not numerous but appeared to be rather interesting. In addition, the faunal remains collected there were numerous (this is one of the most productive sections in that respect). Finally, this place was especially saturated with dog excrement, which was located in a rounded area covering about 1 $m^2$.

The excavations of Sections 49, 50, 53, and 54 gave poor results. The cultural layer was almost completely absent because of the type of stratification: a solid ice interbed was found immediately under the active horizon from 15 to 20 cm deep. It is most likely that all the deposits slid away inasmuch as there was an ice interlayer 20 to 30 cm thick, whose upper surface was a perfect slickenslide for overlying strata. Obviously, the same theory could be applied to extinct deposits that once covered the south side of the cape, where an analogous ice slickenslide was found in 1989 (Pitul'ko 1990:Field Report, Fig. 15), and perhaps to those of the cape extremity as well.

Few finds were excavated in Sections 49, 50, and 54. They were most likely transported from the remnant of a cultural layer found farther upslope from the thermokarst depression, in the direction of Line 14 (Figures 9, 14). Yet the cultural layer excavated in Section 53 remained more or less undisturbed, though some features of sliding were observed. As the other sections, it should be noted that the layer located between Lines 12 and 14 (Sections 61–64) was never seriously damaged. The composition of the layer found in these sections was characteristic of the site, although neither artifacts nor bone fragments were numerous. Nevertheless, it was exactly there where a unique wooden artifact was discovered—a sled runner (Figure 26; Pitul'ko 1991:Field Report, Fig. 30). Other wooden pieces were abundant; most of them were large fragments of split posts (Figure 17).

Thus it can be concluded that the cultural layer in the West area was excavated completely. It thins out (Figures 12, 13) in the direction to Line F and to the extremity of the cape (Line 1). Considering the wood pieces observed on the surface of the east dig area and the numerous bone fragments found on its slope, the cultural layer remains more or less undisturbed in this section, though it was affected by cryogenic processes and solifluction. To my mind, the flat area lying in the direction toward Line F, where the cultural layer abundant with wood, bones, and artifacts (Figures 14, 17) still remains intact and not affected by sliding, has the best prospects for successful excavations in future.

As is obvious from the foregoing descriptions, a huge amount of diverse organics, including hair and excrement, are well preserved due to the conservative aspects of permafrost. Bone, wood, and charcoal specimens were carbon dated in three laboratories, giving a solid background for dating the site. Besides the above-mentioned dates, there is a large series shown in Table 1 below. Most of the dates were obtained by Yu. S. Svezhentsev, from the Institute for the History of Material Culture in St. Petersburg (lab index LE). Smaller series were obtained by Kh. A. Arslanov from St. Petersburg University (lab index LU) and by L. D. Sulerzhitsky from the Institute for Geology, Moscow (lab index GIN). It can easily be recognized that the dates obtained separately correlate well and, equally important, there are close correlations between dates obtained from organic samples of different origin (bone, wood); however, the only date

**Table 1. Radiocarbon dating of the Zhokhov site. Dates are calibrated in CALIB Rev. 3.03c (Stuiver and Reimer 1993). Codes are from: LE—Radiocarbon Lab of the Institute for the History of Material Culture (RAS, St. Petersburg); LU—Radiocarbon Lab of the St. Petersburg State University; GIN—Institute for Geology (RAS, Moscow) Isotope Lab.**

| | | | Calendar BP age ranges | |
|---|---|---|---|---|
| **Lab & sample code** | **Sample** | **Radiocarbon age BP** | **One Sigma** | **Mid-value** |
| LE-3527 | charcoal | 8563 ± 180 | 9381–8948 | 9189 |
| LE-3528 | fragmented bones | 740 ± 190 | 9446–9270 | 9377 |
| LE-3529 | fragmented bones | 8,050 ± 70 | 8532–8379 | 8433 |
| LE-3530 | wood | 12,600 ± 250 | 14,609–13,912 | 14,240 |
| LE-3531 | wood | 7520 ± 150 | 8080–7782 | 7920 |
| LE-3532 | wood | 7640 ± 55 | 8108–7967 | 8048 |
| LE-3533 | wood | 9010 ± 140 | 9843–9468 | 9626 |
| LE-3534 | fragmented bones | 7810 ± 180 | 8390–8018 | 8215 |
| LE-3535 | wood | 7910 ± 180 | 8492–8127 | 8328 |
| LE-3536 | antler | 8610 ± 220 | 9444–8951 | 9232 |
| LE-4048 | wood | 8930 ± 180 | 9813–9383 | 9511 |
| LE-4048* | | 7880 ± 180 | 8368–8192 | 8309 |
| LE-4533a | fragmented bones | 10,810 ± 390 | 12,733–11,531 | 12,311 |
| LE-4533b | fragmented bones | 7940 ± 170 | 8527–8151 | 8351 |
| LE-4534 | wood | 7450 ± 220 | 8079–7634 | 7879 |
| LE-4534* | | 7890 ± 150 | 8424–8133 | 8315 |
| LU-2432 | wood | 7870 ± 60 | 8348–8209 | 8303 |
| LU-2433 | wood | 7860 ± 40 | 8324–8232 | 8296 |
| LU-2499 | wood | 8020 ± 50 | 8476–8370 | 8409 |
| LU-2502** | detritus | 8790 ± 90 | 9482–9351 | 9422 |
| GIN-6399 | wood | 8200 ± 40 | 8707–8549 | 8619 |
| GIN-6400 | fragmented bones | 7930 ± 40 | 8376–8312 | 8343 |
| Average (except LU-2502 sample) from sum of probability distribution | | | 8480–8175 | |

Notes:
* secondarily measured;
** sample from the underlying stratum; the others are from the cultural layer taken during the excavations.

on charcoal deviates from the mean. The dates are mainly from the interval 7800 to 8000 BP (noncalibrated). Thus the age of the site could be dated to that time, i.e., to the Early Holocene. Besides, sample LU-2502 gives the earliest reasonable date. As far as the few deviations are concerned, their occurrence, in my view, cannot be explained by the presence of some unidentified ancient component since they are older than the LU-2502 sample coming from the underlying stratum. They are not organized in either the stratigraphy or the planigraphy; at least a part of them were sampled under exactly the same conditions as the "normal" dates. The period of habitation of the site (or, most likely, the succession of habitations of different durations) does not exceed the precision of carbon dating and probably covers an interval of 200 to 300 years. The seasonality of the site will be discussed below.

From an archaeological point of view, the fine microprismatic blade assemblage of the Zhokhov Island site, as well as other Early Holocene sites known both in the Arctic and in the

Subarctic areas, can indisputably be interpreted as a site of the Mesolithic period. However, anticipating careful consideration of the materials excavated, I would like to digress from the subject to discuss some problems concerning the term "Mesolithic."

## 3.3. The Mesolithic as a Division of Archaeological Periodization

It is generally known that some theoretical notions of archaeological periodization, such as "Mesolithic" or "Eneolithic" in particular, remain under discussion because of the divergence sporadically appearing between a research interpretation of assemblages and canonical definitions of divisions. From time to time, discussion focused on regional features of materials requires a general definition. The period from the late 1940s to the early 1980s was very productive in Russia in this respect, and a lot of general theoretical questions about cultural definitions, chronology, and periodization were considered. Although Mesolithic problems were more popular in the 1960s and 1970s, they are still topical.

In my view, the subject of such discussions can be recognized as a problem of transitions (Pitul'ko 1991e) inasmuch as the latter undoubtedly have common features irrespective of chronology. At the same time, it is obvious that classification (periodization) covering global cultural phenomena in general has to be minimized to a few taxonomic divisions. Naturally, Stone Age and Metal Epoch can be recognized as the most general divisions, inasmuch as the Copper, Bronze, and Iron Ages are subdivisions of the latter, and metallurgy as a global cultural phenomenon occurred as a result of the spread of iron metallurgy. But if the Metal Epoch can be structured easily according to a type of ore (more accurately, a type of metal), the classification of Stone Age phenomena can only be based on archaeological criteria. Social or economic grounds are thought to be irrelevant for archaeological periodization since the latter, the result of interpretation of the original archaeological information, became a taxonomic system existing parallel with the archaeological one (Vishnyatsky 1989). But even if they are very often considered criteria for classification (periodization) of the Stone Age, such as the Mesolithic, Neolithic, and Eneolithic (Grigor'yev 1970; Rogachev 1966; Formozov 1970; Dikov 1979), it is obvious that if the general target is archaeological periodization, then archaeological criteria should be chosen for the subdivisions to be defined (i.e., artifacts, structures, faunal remains, etc., differ from others put into neighboring cells of periodization and comprise a different essence).

Of course, features most distinctly characterizing differences between cells, such as ceramics or the processing of metals—commonly in use as firm criteria for periodization—are the most obvious for that of archaeological material in the general sense; still, ceramics remain a secondary (but very distinct) indication of a particular period. But if we recall that the basic principles were advanced in Thomsen's time and developed later, it becomes obvious that the evolution of the manufacture of the raw material of one or another kind, i.e., technology of tool processing, has been permanently considered the most general basic principle of the archaeological periodization. This point of view is popular in Russia (G.P. Grigor'yev, A.N. Rogachev, A.A. Formozov, and others are of this opinion). Taxons recognized in this way present themselves as technological phenomena (for example, Mousterian and Upper Paleolithic). Logically one could apply technological indications as a basis for periodization in general. Doing it this way, primary (transition from stone-based to metal-based technologies) and secondary (progress, or sequence, of technologies based on stone raw material) transitions can be found. The essence of technological progress is a sequential occurrence of advanced technologies supplanting former ones in the sphere of manufacturing the most important tools, though supplanted technologies can survive for a very long time in parallel with more progressive ones without any regression or regressing gradually, as took place in Northeastern Siberia. The chronological interval covering the transition period can be rather long, and in my view, its end can be marked by a new technology predominating worldwide. Naturally, it is possible to define additional (second order) taxons (such as Neolithic I, II) if necessary for more precise consideration of a transition period, working out the structure of regional periodization or a local sequence. It seems possible that the features of transitions occurred most distinctly during the period of the global spreading of new technological principles, i.e., during the Stone Age–Metal epoch transition (Pitul'ko 1991c; 1991d). The Mesolithic term implies exactly the same well-recognized, but of a second order, transition process.

The term itself was advanced for the first time by A. Brown as far back as in the 19th century regarding some relics found in France, and it was recognized by the European archaeologists. This happened primarily owing to the publications of G. Child, who gave the first real theoretical background for the Mesolithic division and pointed out a strong correlation between the material culture and the beginning of Holocene environmental changes. In Russia, recognition of this term is associated with the publications of M.V. Voevodsky, who applied Child's Mesolithic theory to Early Holocene sites in European Russia (1950). However, it should be noted that the term did not so much naturalize (Koltsov 1989) over time as become a catalyst for the discussion on the Mesolithic as a subdivision of periodization, slowly moving forward. And the discussion still is not finished since participants prefer to retain their own views. Some researchers consider the Mesolithic notion as an artificial one. However, this term is no more artificial than other notions of archaeological periodization. If notions such as Mesolithic, Epi-Paleolithic, Holocene Paleolithic were simply synonyms (as can be seen, for instance, from Kol'tsov's publications), discussion would have ended many years ago.

All the various views advanced during the last 25–30 years concerning the Mesolithic can be summarized as follows: (1) the chronological approach—ascribing primarily chronological significance to the term; (2) the ecological approach—the recognition of paleoecology and the correlation between ecology and both social and economic changes; and (3) the typological and/or technological approach.

There is no doubt that in following the first way researchers substitute periodization for chronology. Although the parallel is incorrect in theory, periodization may correspond to chronology, and moreover, each notion of periodization, being a subdivision of some chronostratigraphic system, has a chronological implication anyway, even if we do not like it. The latter is characteristic of the Mesolithic subdivision because as a rule its lower boundary corresponds to the Pleistocene-Holocene boundary. The second way appears to be incorrect as well, because it is based on interpretations of the original archaeological information and not precisely on the artifacts. Therefore, the third way is the only well-grounded approach for working out the archaeological criteria of the Mesolithic subdivision. The typological and/or technological approach has been supported by many researchers, such as A.A. Formozov (1970), G.P. Grigor'yev (1970), V.A. Lynsha (1978), and L.B. Vishnyatsky and Ye. M. Kolpakov (1991). Finally, sporadic attempts to prove that the Mesolithic subdivision is part of global archaeological periodization are the major problem and stimulus for contined discussion. This is a kind of theoretical trap. In this connection Vishnyatsky and Kolpakov (1991) have recently noted that there is no reason to find all of the taxons of archaeological periodization everywhere, and further, that even if they had been recognized, there is no reason for regional or local sequences to correspond to each other. The latter is the natural effect of uneven development that has been noted by G.N. Matyushin (1976) and Yu. A. Mochanov (1977) as early as the 1970s.

In that way, the Mesolithic can be defined as a transition period characterized by widespread prismatic microblade industries and tools made from blades, microliths, and inset tools; the chronology of the period corresponds primarily to the Early Holocene. This notion, due to uneven development, cannot be applied to global cultural phenomena but rather appears to be a subdivision of regional and local sequences (Vishnyatsky and Kolpakov 1991), a view I share. Consequently, other notions advanced by some researchers as a contradiction to the term Mesolithic—the Holocene Paleolithic, Epi-Paleolithic, etc.—can be used as well, inasmuch as they are not equivalent to Mesolithic, as N.N. Dikov (1979) supposes, but independent parallel notions in another sense characterizing another cultural phenomenon. Special attention is devoted to this problem not just with regard to the Early Holocene but because a portion of the Late Pleistocene assemblages of Northeast Asia and Alaska are probably illustrative examples for the Mesolithic discussion.

Thus, in Mochanov's view (1977), the Holocene Paleolithic Sumnagin culture occurred in Northeast Asia near the Pleistocene-Holocene boundary. This view is disputed by Dikov (1979) in comparing the Sumnagin stone inventory with undisputed Paleolithic and Neolithic materials coming from the same region. It was recognized that the knapping technology had markedly changed in a very short period (wedge-shaped core technology had completely disappeared for some reason and was replaced by micro-prismatic technology). Bifacially retouched tools (knives, points) known both from Paleolithic and Neolithic complexes are entirely absent. The material coming from the sites dated to the first half of the Holocene can be characterized as a collection of prismatic microblade industries and diverse microblade tools, while the Paleolithic assemblages contain wedge-shaped cores, series of bifacial tools, etc., and the latter appear again in the Neolithic associated with micro-prismatic technology. These are taxonomic differences and thus a separate—Mesolithic—division could be defined in the creation of a regional archaeological periodization. Another good illustration is the Early Holocene Siberdik culture defined by Dikov (1979). Although this culture is contemporaneous with the Sumnagin phenomenon, it differs sharply from the latter because its assemblages contain wedge-shaped cores, choppers, and bifacially retouched tools, i.e., the Siberdik culture is a direct descendant of the local Paleolithic. From the point of view of archaeological periodization, it is defined by the researcher as the Relict Paleolithic, which can not be disputed because this is a true Holocene Paleolithic assemblage.

At the same time, serious problems arise if one applies a general system of archaeological periodization to the Stone Age of Alaska, where only two major divisions—Paleolithic and Neolithic—can be accurately recognized. All of the assemblages are of Late Paleolithic character up to 4000 BP, when more or less definite features of industries of Neolithic type appear among them. In fact, all of the stages up to the Late Neolithic are missing in this area. In considering the materials, A.M. Kuznetsov (1988) concluded that in this case it would be correct to use the combined notion of a Late Paleolithic–Mesolithic period, though the term Holocene Paleolithic is absolutely correct. In my view, both the Northeast Asian (Siberdik and Sumnagin) and Alaskan examples illustrate well the thesis under consideration (that is, to recognize the Mesolithic as a notion of a regional system of archaeological periodization).

## 3.4. The Stone Industry of the Zhokhov Island Site

The finds (artifacts of stone, bone, antler, mammoth ivory, and wood) comprising the Zhokhov assemblage come from both excavations and surface collections; some artifacts were gathered here and there, being pushed to the surface by cryogenic processes, or being redeposited in creek valley accumulations as a result of partial destruction of the cultural layer. The latter are few in number. The major part of the collection, obtained during the two-year excavations (its total quantity is about 1,000 items, excluding faunal remains), is represented by stone artifacts.

Different sorts of raw material were used by the inhabitants for stone tool manufacturing, including some kinds of flint and flinty tufas, sandstone, chalcedony, and obsidian. The obsidian and the high-quality flint were undoubtedly imported, while the other kinds appear to be local. For example, flint pebbles, colored in a range of brown tints, are numerous on the island. Exactly this kind of flint was regularly used for processing stone tools, while the other materials, especially obsidian and high-quality flint, were used more rarely.

The quantity of primary and semi-primary flakes (i.e., those retaining cortex) is extremely low, suggesting that initial stone processing was accomplished either outside the site area or on some specific section(s) of the site. The lithic technology is definitely of Mesolithic character: regularly faceted blades and microblades—mainly fragmentary—constitute about half of the collection (artifacts recognized precisely as microblades constitute 27.4% of the collection, and most of them, both the intact and the broken ones, have a width of about 7 mm, with only isolated specimens wider than 9 mm). Table 2 describes the general composition:

Analysis of the stone inventory from the Zhokhov site allows singling out three narrow technological contexts (this apt term was advanced by E. Yu. Giria [1991]), i.e., three groups of artifacts constituting three basic objectives of knapping: (1) the manufacture of axes and chisels

**Table 2. Stone tool collection from the Zhokhov site: Number of artifacts per category.**

| | |
|---|---|
| Pre-cores | 15 |
| Cores | |
| with one flaking surface | 8 |
| with two adjoining flaking surfaces | 11 |
| with two separate (opposite) flaking surfaces | 13 |
| with three adjoining flaking surfaces | 11 |
| with four adjoining flaking surfaces | 2 |
| Total | 45 |
| Lamellar flakes (mainly technological) | 199 |
| Blank bladelets | 18 |
| Medial blade sections | 20 |
| Blade insets | 7 |
| Fragment of bifacially flaked piece | 1 |
| Polished adzes | |
| Intact | 2 |
| Fragments | 4 |
| Flakes | |
| primary (cortex) flakes | 13 |
| with polished dorsal surfaces (flaked from polished tools owing to re-shaping, or sharpening, etc.) | 21 |
| other flakes | 44 |
| Total | 78 |
| Irregular pieces of raw material, crumbled pebbles, etc. | 83 |
| Abrasives | 5 |
| Pieces of pumice stone | 13 |
| **Grand Total** | **488** |

from low-grade siliceous slates; (2) the manufacture of blades; (3) the manufacture of insets for side-bladed tools from flint and obsidian (Giria and Pitul'ko 1994).

The manufacture of adze-type tools was performed in two stages: preliminary flaking and final processing by grinding. These tools are represented by a variety of flakes, finished articles, and abrading tools, as well as flakes resulting from initial processing and reshaping. Thanks to the morphological peculiarity of the products knapped and the specific character of the raw materials, it is not particularly difficult to pick out articles that belong to this technological context.

Adze-like tools are extremely rare in the collection. Intact artifacts (two specimens) of this category are known from the surface collections and only found in the creek valley accumulations. One adze was made by polishing a greenstone slab; it has a sharpened butt, rather symmetrical working edges, and a flattened profile, which follows the outlines of the natural preform (Figure 27:1). The second was manufactured from black tufa (Figure 27:2). A small part of a previous working edge, preserved on the butt of this tool, indicates that it was remade from a broken adze with one convex side; the fractured and rejuvenated tool thus kept its original function. Both tools have ground working edges and butts but the latter, made of black tufa, has polished surfaces partly removed by flaking. Thus one can assume that the adze made of black tufa was polished completely (or almost completely), unlike the other one. It is worthy of note that the age of the assemblage containing the ground tools is abnormally early for Northeast Siberia (although there are some regions where such artifacts dated to 8000 BP are rather ordinary—Karelia, for instance). As far as Northeast Siberia is concerned, the adzes with ground working edges that have been excavated in the region from Early Holocene sites are much younger. Thus, Mochanov, in studying the materials coming from the Sumnagin Mesolithic sites, has come to the conclusion that flaked adzes with ground working edges occurred sporadically in Northeast Siberia during the final stage of development of the Sumnagin culture (i.e., ca. 6000 BP), while serial types of polished tools occurred in later times (Mochanov 1977:222). There is no reason to suggest serial production for ground adzes somewhere around Zhokhov Island. However, it is quite clear that a technology for stone grinding was well known to the natives of the Zhokhov site and was permanently in practice. It needs to be stressed that these artifacts create the impression of a mixed chronology (i.e., provoking the assumption that the assemblage is a composition of two different chronological facies of the material): I myself was under this impression for a short time because these artifacts were in fact found before the first excavations in 1989 during a period of snow melting. However, they are indisputably connected with the main part of the finds discovered *in situ.* Some fragments were excavated, as well as chips flaked off for reshaping (or resharpening) such tools, with completely polished dorsal surfaces and made of the same (greenstone) raw material. As far as the above-mentioned fragments are concerned, especially characteristic pieces were found: a butt section of a large ground tool (Figure 27:4) and the working part of a completely ground adze with a rounded transverse profile. It is interesting that the latter, having completely lost its original function (the working edge had most likely been resharpened several times and finally become blunt), was broken and reused as a core. The feeble attempt to take off some flakes is illustrated by several irregular scars (Figure 27:3).

The manufacture of blades is not represented in full technological context. There are only two lamellar flakes, the distal part resulting from such knapping, and two distal parts of blades (Figure 28:5–9). To all appearances those were rather large flakes (compared with the rest of the materials in the collection); their length was up to 44 mm or even longer and their width up to 18–23 mm. They were manufactured by direct percussion from cores, whose morphology is difficult to ascertain since there are only five fragments of such flakes. The collection also includes a number of flakes that are difficult to attribute to any particular context. These are primary and nonprimary flakes (43 pieces) resulting from direct percussion.

The technological context of manufacturing insets for tools with grooves, i.e., points and knives, is more completely represented. These are insets themselves (in and out of settings), fragments of blades, blades, lamellar flakes resulting from the shaping of the prismatic relief of the flaking surfaces of cores (Figure 28:13–22), cores, pre-cores (Figures 29:10; 30), and flakes from pre-core platform preparation. The association of bladelets and blade-flakes to the same context as the cores found at the site is confirmed by both their morphology and their common dimensions. The technological similarity of the cores and pre-cores singled out in the collection is demonstrated by morphological characteristics and similar dimensions common for both groups, as well as by analysis of the morphology of the flakes that create prismatic relief on the core flaking surfaces, i.e., flakes by means of which pre-cores are turned into cores.

Since the technology of acquiring bladelets in the Zhokhov industry represents a method that has no analogies in the archaeological literature, and moreover, since the integrity of the context of bladelet manufacture singled out in this industry requires special proof, the technological analysis of this stage of the knapping sequence calls for particularly careful description, reasoning about all kinds of technological links, and providing for the established sequence: insets—bladelets—cores—pre-cores.

The raw material for inset manufacture in this industry was flint and chalcedony pieces of slightly rolled rock debris from deposits on Zhokhov Island. Articles made of obsidian have also been found; the origin of obsidian is not known.

Insets in settings, preserved *in situ*, are medial parts of bladelets made of flint or, very rarely, of obsidian. Their length fluctuates within a range of 14–25 mm. The longest ones are usually found broken in the setting; thus both fragments are situated nearby in the groove. The insets' widths are 3.2–7.5 mm. The length of the fragments is more than 11 mm. All insets found *in situ* in the grooves have edge damage on the blade—rather uniform minor faceting on ventral and dorsal surfaces (half-moon scars and facets with various types of termination with a length of no more than 1 mm).

The collection includes 27 medial parts of bladelets. Seven of them have edge damage characteristic of the insets found *in situ* in the tool settings. These items are 11–18 mm long, which makes it possible to identify them as insets that have slipped from the setting (Figure 28:1–6). The remaining 20 medial parts of bladelets do not have characteristic edge damage and are shorter (length of 5.5–8.3 mm). These are evidently waste products or the results of poor breaking of the bladelets.

In this industry insets were manufactured by means of deliberate breaking of the bladelets, which is proved by the rather standard length of the fragments. Most probably fragmentation was not a specialized aspect of production. Bladelets were simply broken; no retouch truncation is found on the medial parts of the bladelets.

Bladelets that are half-finished products for insets are well represented in the collection (Figure 28:7–12). This type of bladelet dominates in number not only lamellar flakes but also when compared with other knapped products. All in all there are 126 such bladelets, which amounts to 63.3% of the total number of lamellar flakes. These are flakes with a length that is 3 to 5 times that of the width, the edges are parallel, the interfacet edges on the dorsal surface are also parallel, and the cross section has the form of a trapezium or triangle. In addition, both edges of these flakes have sharp angles between ventral and dorsal sides. The direction of scars on the ventral surface corresponds to the direction of the knapping of the bladelet itself. The maximum length of bladelets is 37.5 mm, minimum 18 mm. Width is 3–5 mm, thickness 2.2–1.1 mm. Curvature is 2.2–1 mm, that is, minimal. Most bladelets are characterized by a rather straight side view. It is worth mentioning that the medial part of the bladelet is the straightest; the proximal part has the bulb of percussion, and the distal end is the most curved. The projection of most bladelets is almost rectangular, at the same time a slight increase of the flakes' widths (divergence of edges) in the distal part is obvious. For manufacturing insets most correctly, narrow bladelets were used.

The platforms of all bladelets are either processed or retouched; 98% of bladelets with proximal ends (122 items) have traces of overhang removal; among them 24% are characterized by strong reduction of bladelet platforms, 79% by slight reduction or leveling.

The group of bladelets is closely connected with the group of cores. There are no cores in the collection whose morphology showed any other types of lamellar flakes being removed. The bladelets fully correspond to the cores available in the collection, both morphologically and by any other parameter—length, width, degree of curvature.

Items with scars on the surface showing bladelet removal are referred to as cores. Groups of such scars form the flaking surface (front). Flaking surfaces on cores from the Zhokhov industry are wide and flattened. The term "wide" implies that the surface is three or more times wider than the width of blank. Flattened indicates a flaking surface with a small degree of prominence.

The collection includes 45 cores, 9 of which are the so-called "tortsoviye"-type cores with rather narrow flaking surfaces (average 12 mm). In this context the term "tortqoviye"-type does not refer to the core type proper; it only indicates that the flaking surface of this core is situated on the edge facet of the article knapped. All these cores are made of slab raw material—siliceous rock debris—characterized by narrow edge facets (such morphology of cores was largely predetermined by the form of the raw material). The remaining cores have flaking surfaces of up to 27 mm wide. The width of the insets is 3.2–7.5 mm. Hence, flaking surfaces of most cores in this industry are wide enough for three or more blanks.

The degree of prominence of the flaking surface is larger on cores with a wide front (up to 3–4 mm) and smaller on cores with a narrow front (up to 1 mm). The convexity of the core's flaking surface is uniform along the whole flaking surface from its platform to its base. The same can be said about the width of the flaking surface: its dimensions at the platform and at the base are practically the same in most cases, so the flaking surface is almost rectangular in the plane view.

Flaking surfaces of prismatic cores with such morphology allow the removal of bladelets with a straighter profile since a plunging termination of the flake is not possible in this case. Thanks to the strict flatness of the relief of the flaking surface, bladelets taken from these flaking surfaces have the sharpest possible lateral edges, which are caused by the proportions of the thickness and width of such flakes. When the convexity of the flaking surface is great and the front is narrow, the bladelets will be thicker and narrower, while in the case above they are comparatively wide and thin.

When viewed from above the platform, the radius of rounding of the flaking surface with a small degree of prominence is rather large; for cores with a narrow convex front, it is relatively small. If we extend the circle along the arch of the front's convexity, the first type of core will have a large circle and the second type a small one, which is why such cores can be rather tiny, having a round platform. Cores with a flattened wide flaking surface frequently lack such morphology simply because of the large radius of the circle. The diameter of cores with a "round" platform for manufacturing bladelets of the Zhokhov type would have been from 20 to 40 cm. Raw material of such size would not only have created extra difficulties during its processing but is rather rare.

Is a round flaking surface of so important? Such cores have been found in collections representing industries of bladelet manufacture from different periods and regions—an indisputable fact. But how were they manufactured? What was their processing, the sequence of taking off bladelets? Too little reliable information exists to answer these questions.

From the point of view of knapping technology, cores with such flaking surface do not benefit in comparison with unilateral cores; quite the reverse. If we assume that taking off blanks was executed continually around the "circle," then every circuit (row) of blanks should cause a decrease in the core diameter. This would inevitably bring changes to the proportions of the blanks. Flakes taken off in the last instance would be narrower and thicker; thus it would be impossible to get blanks with constant values of width, length, and angle of sharpness on the margins (the latter becoming more obtuse as the blanks are taken off).

By contrast, unilateral cores with wide flattened flaking surfaces guarantee acquiring blanks of standard proportions during the whole cycle of knapping the core. Such flaking surfaces are like fragments of a larger circular surface. After the first row of blanks is taken off, the degree of prominence on such cores does not change; each row is parallel to both the previous one and the next one, with the same degree of prominence and width of the flaking surface.

Therefore, using such a flaking surface, namely flattened ones, is the most expedient for taking off blanks for insets. As insets, it is true that blades of a certain length require not only straightness of the profile, parallel edges, and sharpness but also mass production of standard bladelets.

For consecutive removal of blanks from cores with such morphology of the front, it is essential to have two straight side-edges of the core, without convexity or concavity of relief, that join the flaking surface at this or that angle.

It is supposed that the two edge flakes should be taken off such a flaking surface in each row. It is these blanks that make it possible to raise the flaking surface relief in case it gets too flattened during the removal of bladelets. Both of these flakes should be lamellar—their length should not be less than that of the flaking surface. Otherwise, the hinge termination caused by too short an edge flake would prevent one from taking off bladelets. The collection of the Zhokhov industry sufficiently represents edge flakes of this type. There are 59 such items (29% of all lamellar flakes). It is one of the most representative groups; it is lower in quantity only to bladelets (Figure 28:6–8, 10, 11).

For successful knapping along the plane separating an edge flake from the body of the core, it is necessary for the relief of the flaking surface to be as straight as possible.

Usually edge flakes are two- or three-edged. One facet remains from the scar of the previously removed bladelet, that is, part of the flaking surface. The second (or the rest) facet is part of the side surface of the core. If the relief of the side surface is rough, taking off the edge flake becomes more complicated. If removal is poor, taking bladelets from the flaking surface becomes impossible. That is why straight side surfaces are technologically essential.

For the cores from the Zhokhov Island's collection the following three methods of processing and straightening of the side surfaces are observed: (a) selection of raw material in natural slabs; (b) leveling of side surfaces with transverse flaking; (c) leveling of side surfaces with longitudinal lamellar flaking. None of the three methods was absolutely independent since they were often used in combination on one and the same core.

Selection of the natural form of the material demands no special explanation (Figure 31:1–3). These are not just cores of the tortsoviye type (Figure 31:3). Edge flakes removed during the knapping of these cores are represented in Figure 28:18–20, 26. Leveling of side surfaces with transverse flaking is represented by two cores (Figure 32:1, 2). In both cases the flaking surface is contiguous on one side with the side surface leveled by transverse flaking, and on the other side by the chosen plain natural surface. Figure 28:17 shows an edge flake taken off such a side surface. Flakes resulting from the leveling of side surfaces on both cores are rather lamellar, but at the same time these surfaces do not have the regular cut characteristic of flaking surfaces.

The third type of side surface leveling, represented on most cores, requires a special explanation. Here we actually have cores with two, three, or even four morphologically similar surfaces shaped by lamellar flaking. Most often each pair of such surfaces is situated on the core at a 90° angle to each other. Sometimes bladelets were taken off in different directions on the two surfaces (Figure 33:2C). In such cases it is not always possible with a sufficient degree of certainty to determine which of the two surfaces was the last flaking surface. Edge flakes taken from such side surfaces are well presented in the collection (Figure 28:23–25).

Is it possible to consider side surfaces leveled with longitudinal lamellar flakes and no connection to the flaking surfaces of the blanks? Analysis of individual cores from the collection does not provide an answer to this question. It is possible that some surfaces were really leveled in such a manner while simultaneously there was no intention of getting blanks during the process. From the point of view of its morphology, a core with such a shape is similar to cores with adjoining flaking surfaces.

All cores in the collection can be classified as follows:

| | | |
|---|---|---|
| 1st group | 8 items | One flaking surface on the edge facet (Figure 31:1). |
| 2nd group | 11 items | Two adjoining flaking surfaces (Figure 34:1). |
| 3rd group | 13 items | Two separate flaking surfaces on two opposite edge facets and a single platform (Figure 31:3). |
| 4th group | 11 items | Three adjoining flaking surfaces (Figure 33:1, 2). |
| 5th group | 2 items | Four adjoining flaking surfaces (Figure 33:3). |

The last group—those with four adjoining flaking surfaces—cannot be regarded as cores with a circular front. First, they are really tetrahedral cores with flattened flaking surfaces. Second, removal of bladelets from these cores was performed not along a circle but from one or two surfaces. Lamellar flakes, whose scars are on the remaining flaking surfaces, were removed not from this platform but much earlier when the core was higher.

These typological groups were singled out taking into account only well-shaped flaking surfaces. However, many cores have scars that show evidence of initial shaping of the flaking surface. Such cores already have one or more flaking surface, and shaping of another flaking surface has begun. Thus a core belonging to the first group (Figure 31:1) has one already-shaped flaking surface on one edge facet of the preform and a prepared ridge that levels another flaking surface on the opposite edge facet. An attempt was made to take off a ridged flake from this surface in order to shape the prismatic relief of the second flaking surface. A core belonging to the second group (Figure 34:1) has traces of the shaping of a third flaking surface adjoining the two previous flaking surfaces (Figure 34:1E). And so on.

Taking into account the presence of such transformations, all cores of this industry can be lined up into the following rows:

| | | | | |
|---|---|---|---|---|
| | | 2nd group | | |
| | | | | |
| 1st group | | 4th group | | 5th group |
| | | | | |
| | | 3rd group | | |

The strength of connection between the groups reflected in the number of core transformations is as follows:

| | | | | |
|---|---|---|---|---|
| | | 2nd group | | |
| | 3 items | | 4 items | |
| 1st group | | 4th group | | 5th group |
| | 3 items | | 2 items | |
| | | 3rd group | | |

Thus, there are two possible explanations for the presence of several surfaces shaped with lamellar flakes on the Zhokhov Island cores:

1. Cores with one wide flattened flaking surface required the leveling of side surfaces, which was sometimes performed by the removal of lamellar flakes from the major platform. Thus the processed side surface "imitates" the shape of the flaking surface.
2. Leveling of the core's lateral surfaces was performed by deliberate transfer of the flaking surface. In this case creation of a lateral surface was combined with the process of removing lamellar flakes, and the core's morphology received controlled change during the course of its use.

It is evident that here the simplest way to a comprehensive explanation is refitting. But the collection from the Zhokhov site does not provide us with enough material to carry out refitting. Moreover, refitting a couple of cores could hardly serve as a reliable demonstration of the knapping method for dozens of others.

The first explanation is based on the analysis of the morphology of individual cores, irrespective of other cores and flaking products. Formal typology distinguishes five groups of cores, though there could be more or fewer groups if other criteria were chosen.

The second explanation is based on comparative analysis of the morphology of different cores in the complex with other knapping products. The main criterion for selecting characteristics in this case is not formal similarity of morphology but ascertainment of the technological necessity of this or that morphology for the knapping objectives. Thus this interpretation is based on purely technological criteria. Classification of material based on technological analysis does not single out individual groups of material but is aimed at looking for possible ways to reconstruct their initial integrity (in other words this is also a kind of refitting but in a more general sense).

The above-mentioned schemes indicate that the amount of transformation linking separate groups together is up to 40% of the cores in these groups. This fact alone indicates the non-accidental character of the stated relations, even based on not much material. With the strictest approach, the number of cores that belong to the pure groups (with one, two, or more flaking surfaces) is not that large. On the contrary, during the course of comparison, different cores indicate smooth morphological changes.

Most of the worn-out cores belong to the fourth group, i.e., cores with three adjoining flaking surfaces. By a worn-out core we mean one with its body worn out to the maximal extent from blank removal. Such cores have the least potential compared with other cores represented in the collection (Figure 34:2). The fifth group of cores, i.e., those with four adjoining flaking surfaces, is only a variant of the fourth group. Worn-out cores with such surface distribution do not occur.

The unity of the basic objective of knapping cores is confirmed by the method of shaping their platforms. It is somewhat specific and similar for all the cores. The scars help follow the general tendency; platform preparation was performed in two steps. First, the whole surface constituting the core's general platform was shaped by taking off flakes from one of the lateral surfaces; then the edge of the platform adjoining the flaking surface was processed with fine pressure retouch. Leveling of the platform from its lateral surface is in most cases distinctly oriented transverse to the direction of leveling the edge. In some cases it is possible to judge, based on the model of the platform formation, which of the surfaces of the core was the last flaking surface. On cores having one or two non-adjoining fronts, this dependence is strictly observed. In cases when adjoining flaking surfaces appear, platform edge preparation is the last to cover the surface crosswise. But even then it is frequently possible to find out which of the flaking surfaces was the last to be processed with retouch trimming.

Some idea of the location of former flaking surfaces can be based on the orientation of flakes with which the base of the core was prepared. For cores in the first and the third groups this preparation was exercised on the left side parallel to the initial platform preparation. As the result the base of the core acquired an almost flat surface parallel to the plane of the flaking surface. Such preparation made it possible to use the base later as a platform for a flaking surface on the lateral surface of the core by taking off flakes from the bottom.

These arguments make it possible to consider cores from the Zhokhov Island collection not as a set of typologically different forms but as an evolutionary sequence of core morphologies, while producing blanks was performed by a common technology.

The presence of one or two lateral surfaces, flattened by the removal of blade-like flakes parallel to blades from the current flaking surface, is the most convenient method of leveling. Edge flakes removed from the edge between this lateral surface and the flaking surface are actually blades or bladelets. It is just that one of its edges has a larger angle of sharpness. On the other hand, it is the simplest and most effective method, though it requires either preliminary preparation of the lateral surface or selection of a flat natural surface.

Cores of the first group have just such morphology. Blanks are produced from one flaking surface situated between two natural, plane surfaces. When the body of the blank becomes elongated the second flaking surface, like the first, is formed on the opposite edge facet. Thus, cores of the third group are a version of cores of the first group.

The same lamellar flakes were taken off cores having the morphology of the first and the third groups. It was not necessary for them to be bladelets. At this stage of processing ridged blades, initial, semi-initial, and other types of flakes shaping the prismatic relief of the core were most likely removed. As for the core length, it was somewhat reduced. When the core's body length reached the degree of width necessary for the flaking surface, a new front was formed then on a lateral surface. Its average size for cores from the Zhokhov Island is 20 mm.

The shaping of a new flaking surface was performed either between two previous surfaces (if cores morphologically of the third group were initially used) or between the flaking surface and the back side of the core (in case of cores with first group morphology). The flakes shaping this surface could be directed both from the main platform of the core and from the side of the base.

In this way cores belonging to the second and the fourth groups were formed. Shaping of the side flaking surfaces was performed from edges to the center. The collection includes the flakes that shaped the prismatic relief that probably completed this process. These were three-edged lamellar flakes, whose central edge was the natural surface of the raw material—the remains of the lateral surface of the core (Figure 28:21, 22). There is no absolute certainty that these flakes originated during the course of the flaking procedure since the same flakes could have been produced during the shaping of any other flaking surface.

As already mentioned, the morphology of the cores that belong to the fifth group does not allow them to be regarded as an independent core form. They are a combined version of cores belonging to the second and the fourth groups. When all four flaking surfaces are used on cores of this type, the width of the flaking surfaces cannot avoid being reduced, which in turn would lead to a change in the blank's morphology.

Thus it can be stated that technological analysis of cores produced on the Zhokhov Island has revealed the following:

1. All cores from the collection have wide flattened flaking surfaces.
2. Leveling of the core's lateral surfaces was carried out:
   a. by selection of flat natural surfaces;
   b. by transverse flakes;
   c. by longitudinal flakes;
   d. by regular transfer of the flaking surface to the lateral surfaces of the core.
3. All forms of cores available in the collection represent different stages of a single knapping method.

Pre-cores in the Zhokhov collection were catagorized according to morphological characteristics, dimensional parameters, and morphology of flakes that form prismatic surfaces common for cores; 15 pre-cores have been selected (Figures 29:10; 30:1–5).

The pre-core and core forms were to a great extent dependant on the initial form of the raw material. In the selection of raw material for manufacturing pre-cores, preference was given to cubic and pyramidal forms. Single pieces of rock with one or two flat surfaces were used. Pre-cores were manufactured from thin slabs. If there was no surface to create a platform on a piece of rock to be used for pre-core manufacture, then knapping began most frequently with platform production. The major requirement for a platform was its placement on a plane perpendicular to the lateral surfaces of the preform. So the platform was first shaped with a couple of centralized flakes. Then perimeter flaking took off a flake in the plane of the desired preform's cross section, during which strokes were applied to the edge part of the lateral surfaces. The force of these strokes was not meant to remove a spall that would shape the platform at a single stroke.

On the contrary, perimeter flaking was performed with light strokes from a hammerstone, which created undeveloped knapping surfaces inside the blank—cracks in the form of a cone that fade away without reaching the surface. During such processing, inside cracks that envelope the preform of the pre-core along the plane of the desired cross section were intersected, and at a certain moment after the next light stroke the flake shaping the platform was separated from the preform. Such a flake has a centrally oriented scar on the dorsal surface as well as a rather peculiar appearance on the ventral side that was formed not by the usual single bulb of percussion but by a combination of three to five cones. The collection includes 35 flakes for shaping the pre-core platform with such characteristics, that is, 44.8% of the total number (78) of flakes.

The dorsal surface relief of such flakes fully corresponds to the character of pre-core platforms left at this stage of processing. This can be proved if one compares the character of the pre-core platform relief (Figure 29:10) and flakes of shaping such platforms (Figure 29:1–4). It calls attention to the fact that some flakes with wide platforms have traces of multiple strokes—cone-like cracks; 5 of 35 such flakes have no proximal parts. Of the remaining 30 items, 8 have natural platforms, 21 prepared platforms, and 1 retouched platform.

Many pre-cores were subjected not only to platform shaping but also to leveling of the base. The major part of ready-to-knap cores of this industry have a flat, deliberately leveled base (Figures 31:1F; 33:2E, 3F; 34:1F, 2E, 3F).

The lateral surfaces of pre-cores were most often natural surfaces of well-selected initial forms of the raw material. If the relief of these surfaces did not satisfy the master, they were leveled by flakes whose platforms were natural edges. In other knapping technologies, widely known ridges were formed on pre-cores and intended for removal as the first ridged blade (Figure 30:1C, B).

It is worth mentioning that this industry lacks pre-core edges; its flakes were removed from the perform in two directions (by a cross wise method)—all edges shaped with flakes are unifacial. Most edges between the lateral surfaces of pre-cores are the natural edges of siliceous rock debris selected for knapping (Figure 30:2, 4, 5).

The morphology and metrical parameters of ridged blades, initial flakes, and other flakes shaping the prismatic relief of the flaking surface correspond fully to the morphology of pre-cores. Lamellar initial flakes removed from natural edges are prevalent—five items, or 7.5% of the total number of lamellar flakes (Figure 29:13). Ridged unilateral blades make up 3% of ridged flakes, two items (Figure 29:14, 15). More numerous are blade flakes intended for broadening the limits of the future flaking surface (Figure 29:17–20); they are 41.5% of the total number of lamellar flakes. Some of them (Figure 29:18, 19, 20) could be taken off not only during the course of preparing the first flaking surface but also during shaping of any of the rest of the pre-core. That is probably why these flakes make up such a large percentage of the total number of lamellar flakes.

The technology for manufacturing insets in the Zhokhov Island industry can be summarized as follows.

Pre-cores were manufactured from orthogonal pieces of siliceous rock debris, exposures of which are found in the immediate vicinity of the site. The major steps in their manufacture were preparing the pre-core platform by means of perimeter flaking, leveling the base, and in some cases leveling the flaking surface by removal of edge flakes that were always oriented in the same direction (Figure 29:1, 2).

With the help of blade-like flakes removed from the main and opposite platforms, pre-cores were transformed into cores, the final processing of which consisted of leveling the platform by removing flakes from one of the lateral surfaces, trimming the edges with pressure retouch, and in some cases additional leveling of lateral surfaces with transverse flaking. The last procedure could be exercised during use of the core in combination with leveling of the lateral surfaces by removal of longitudinal flakes during transformation of the flaking surface into the lateral surfaces of the core. The general strategy of core knapping was aimed at obtaining standard blades with rectangular outlines; this was ensured by constant maintenance of a broad flattened flaking surface. During the course of using a core its morphology was changed. Cores with two or three adjoining flaking surfaces can be recognized as complete forms (the version with four flaking surfaces is considered to be a duplicate of one of the two mentioned above). Insets were produced from the medial parts of blades by deliberately breaking those obtained during the knapping process.

Preparation of pre-cores and leveling of the core platforms was implemented by percussion flaking. Normal pressure knapping was used to level the edges of the striking platform that join the current flaking surface, to level the lateral surfaces that show transverse flaking, and to remove bladelets. Analysis of the flint knapping industry indicates that it was oriented primarily toward obtaining insets of a certain size, the process being noticeably standardized; the characteristics of the bone (antler, etc.) mountings fully correspond to the data of the technological analysis.

Inset tools are part of the hunting equipment complex. Many of them were broken during use; others were reshaped after being broken. The tools' proportions suggest that one-third of the inset (base part or point) was broken off. The base, occupying almost a third of the tools' length, normally lacked additional processing (except in two cases). The points were probably mounted lap-spliced on a shaft and tied tightly with a skin strip. It is well known that even stone points were mounted in that way (Gronnow 1988:24–39). Some tools have been distinctly polished by the strip sections. Grooves are made along approximately two-thirds of the side surfaces; very rarely they are made along the whole length of the tool. The depth of the grooves varies from 3 to 5 mm; the width is usually about 2 mm. Insets preserved *in situ* in the grooves usually project 1.5 to 2 mm, sometimes 3 to 4 mm. The number of insets used for one tool has not yet been determined.

Attempts to manufacture any other tools from blades were not noted. A specific feature of the complex is a combination of the microprismatic technique and the tradition of manufacturing polished tools not found earlier in sites of Northeast Siberia, that have been assigned to the same period (Mochanov 1977).

## 3.5. Assemblage of Hunting Equipment

The collection introduces a series of inset tools (Table 3) that considerably outnumbers all finds known in Middle and East Siberia; besides, the latter go back to different ages (Fedoseyeva 1968; Kozlov 1980:55–61). The collection includes primarily fragments of tools of different sizes with one or two grooves (Figures 35, 36, 37, 38:1, 4, 6) and at the same time intact articles as well as unfinished and reshaped articles (Figure 39:4–6). There are also regular non-bladed tools (Figures 39:3; 40:3) as well as a certain number of tools (Figure 38:3) that cannot be associated with one tool type or another.

Bilateral (with two grooves) and unilateral (with one groove) side-blade points are represented by about an equal number of items (12 and 13 correspondingly). They were manufactured from fragments of large bones, rods of antlers, fossil mammoth ivory, walrus tusk. The last are rare (only 5 items) and the method of their manufacture was evidently similar to that reconstructed by A.K. Filippov (1978) or even simpler. Preforms made of ivory and antler were obtained as the result of longitudinal dissection by sawing with a blade of the same initial raw material; such ivory preforms could also be produced by splitting along their critical axis. The process of manufacturing antler preforms should also include straightening them because of their natural curvature. The sequence of operations and the manner of performing them are well known from ethnography. A detailed description is given by A.P. Okladnikov (1950:205,

**Table 3. Inset tools from the Zhokhov site.**

| | Material of Settings | | | | |
|---|---|---|---|---|---|
| **Type of Points** | **Antler** | **Bone** | **Fossil Mmammoth Ivory** | **Walrus Tusk** | **Total** |
| Bilateral side-blade points | | | | | |
| with three-edged cross section | 1 | 1 | 2 | | 4 |
| with unilateral convex cross section | 4 | 4 | | | 8 |
| Unilateral side-blade points | | | | | |
| with three-edged cross section | | 2 | | | 2 |
| with unilateral convex cross section | 2 | | | 1 | 3 |
| with flattened cross section | | 7 | 1 | | 8 |
| **Total** | **7** | **14** | **3** | **1** | **25** |

206). The tool's surface is as a rule polished; its final processing was performed with abrasives of different coarseness (Figure 41).

Bilateral points, characterized by their large size, are most probably spear points. Available tools and their fragments suggest there were only two types:

1. Massive points with three-edged cross section made of antlers (Figure 36:1) and fossil mammoth ivory (Figure 35:3).
2. Points with unilateral convex cross section and curved rear surface caused by scraping out the spongy filling of the antler or preservation of the original cross section of the ivory surface (Figure 35:1, 2, 4). These tools are less massive than those of the first type; their thickness ranges from 5 to 10 mm. As a rule they are large points with a length of up to 568 mm, though examination of the proportions of most fragments indicates that their average length was 240 to 280 mm. The grooves are 3 to 5 mm deep and 1.5 to 2 mm wide. They were evidently sawed with a thin straight blade along two-thirds of the lateral surface of the tool. The points most frequently had a symmetrical, elongated, sharpened outline; the unilaterally sharpened base lacked extra processing.

Only once did a groove look as if it had been sawed along the whole length of the tool and additional processing of the base for mounting the skin strip (Figure 36:2) recorded. But the most likely explanation for this might be the use of the tool after damage.

A decorative element is worth mentioning—a line engraved along the axis of a bone (Figure 39:2, 5) or antler (Figure 35:1, 2, 4) tool; in some cases there is a natural groove on the surface of the bone instead of such line (Figure 35:5).

The settings of inset tools with one groove can vary greatly. They not only have morphological differences but belong to different functional groups—there are spear points, projectile points, and knives (?).

1. Needle-shaped projectile points have a three-edged cross section and are of different sizes: 129:8:5 mm (Figure 38:2) and 174:8:5 mm (Figure 38:6). The groove occupies two-thirds or three-quarters of the tool's length; its depth is 3–4 mm, its width 2 mm. The first point has insets preserved *in situ* projecting 1.5 mm from the groove; the second point has insets projecting 2 to 4 mm (the tool has 8 insets—6 of flint, 2 of obsidian), the wider insets nearer the base.
2. Massive spear points with a unilaterally convex cross section, made of antler (Figure 36:3) and walrus tusk (Figure 36:4) with insets, were preserved *in situ.* The total length of the points was apparently up to 240 or 250 mm; the dimensions of the fragments are 174:24:6–8 mm and 172:25:12–15 mm correspondingly. Approximately one-third of the tips have been broken off. Another point from this group is represented by a small fragment with two insets. The groove was sawed along the side of a whole point made of walrus tusk. The depth of the grooves is 3 to 5 mm, the width 1.5 to 2 mm, and the insets of black siliceous slate project 2 to 3 mm from the grooves. The point made of walrus tusk has the additional shaping of the base found in the group of bilaterally bladed points (Figure 36:2), where three pairs of grooves were cut through for mounting the skin strip (Figure 36:2, 4).

3. Tools with a unilaterally plane cross section are represented primarily by specimens that are assumed to be knives (Figure 37). They are made of bone and greatly flattened; the base is cut straight. Three of them have insets preserved *in situ* that project 1.5 to 2 mm from the grooves. The depth of the grooves is 3 to 4 mm, the width 2 mm.

This group also includes two fragments which we believe to be dart points (Figure 38:1, 4). One of them has a distinct polished zone where the point joins the shaft, fastened together with a skin strip. The point base is cut straight; some slanting furrows are nearby (probably a decorative element). The groove, which is 3–5 mm deep and 1.5–2 mm wide, is at some distance from the point's base (32 mm and 52 mm correspondingly).

Besides numerous inset tools, some regular non-bladed specimens are included in the collection. They are not numerous. Only four items were found—both fragmented (2) and whole (2). One of the fragmented tools, made of a reindeer metapodial split lengthwise, belongs to the simplest type of bone points, which are extremely widespread. The preform was chosen because of its suitable shape (outlines, sharpness, size), almost completely lacking additional processing. Only the tips and basal parts are worked on points of this type. These points are symmetrical and usually have diverse cross sections, following the original ones of the preform (Figure 38:5).

A fragment of another point made of a thick piece of massive bone seems to be more interesting. This is a three-edged point with both ends truncated (Figure 39:3); the length of the preserved part is 92 mm. A natural groove on one of the edges is slightly widened artificially. This is most likely a fragment of a long, narrow three-edged projectile point of a type well known from Eskimo sites (Arutyunov and Sergeyev 1969; Stanford 1976; and others).

The intact points are significant. One of them, made of split reindeer metatarsal, has a perfectly ground surface. This long (135 mm length), narrow point can be recognized as a needle-shaped point (Figure 40:3). It is noteworthy that its shape is very close to that of an inset projectile point with one groove and a three-edged cross section (Figure 40:6), and this one is probably a preform of the same kind of tool. It must be stressed that, except in the most obvious cases, it is difficult to understand whether the non-bladed tools were really non-bladed. As a rule, the opinion that some artifacts are non-bladed is relative.

Another intact specimen was made of a massive bone and, like the former, has carefully worked surfaces (Figure 40:4). The massiveness of the bone used, as in the case of the preform of the large inset spear point (Figure 39:6), makes it possible to assume that massive fossil bones of some Pleistocene animals—most likely mammoth—were used in both cases. The point (Figure 40:4) has a variable cross section—rounded at the tip and unilaterally convex near the base; the latter is flattened (Figure 39:4). Four small transverse engravings are visible on the flattened side of the base.

Three other specimens that are probably either non-bladed points or preforms are assumed to belong in this category as well. As mentioned above, it is difficult to classify some tools exactly, especially if they are fragmented. These three items made of bone most likely have symmetrical outlines; one of them has a basal part rounded in plan.

But the most interesting and unexpected for the high Arctic site—among artifacts of non-bladed types belonging to hunting equipment—is a harpoon, or most likely a fish-spear point (Figure 40:1). The tool differs markedly from specimens known from cultures whose bearers based their survival strategy on sea-mammal hunting. The bilaterally barbed point, made of antler, is 112 mm long and 12 mm wide and has a variable thickness (3 to 8 mm). Eight barbs, 2 by 3 mm in height, are placed on each side asymmetrically at a distance of 10 to 12 mm from each other. The surface was subsequently carefully planed and polished. The wedge-shaped base constitutes about half of the artifact, the cross section is unilaterally slightly plano-convex, and the profile is spindle-shaped. It should be noted that there is a lack of artifacts that could be considered analogous to the find from the Zhokhov site. However, it is generally close to some Mesolithic harpoons known from South Siberian sites (Medvedev 1980:25, 26). The characteristic shape of the basal part of the Zhokhov harpoon indicates that the tool had been used as a prong of a double-pronged fish-spear point. The complex composition of fish spears and bird darts is well known from both ethnographic and archaeological data obtained in the North Pacific region. It is worthy of note that exactly the same reconstruction is proposed by G.I. Medvedev for one of the most ancient artifacts from South Siberian sites (Medvedev et al. 1975).

## 3.6. Tools of Fossil Mammoth Ivory Flakes

One specific feature of the rich collection from the Zhokhov site is the lack of tools (particularly stone tools), except the inset tools described above, stone adzes, and ivory or antler picks. The bifacially flaked preform mentioned in Table 2 cannot be considered a tool since it could be a core preform or something else; the large flake of greenstone with an irregularly faceted edge (Pitul'ko 1993:Fig. 3:3) could be somewhat dubiously identified as a rough atypical side scraper. Surprisingly, the collection contains no scrapers, though this tool category is usually represented by a great number of items. Perhaps the category is absent because the natives used some unusual materials for making scrapers. Or because of the specific character of the spatial distribution of finds, tools of this category might be concentrated somewhere in an unexcavated area (Pitul'ko 1993).

Thus some flattened pumice-stone items were also found that could be interpreted as scrapers. Abundant flakes of bone, ivory, and antler, diverse in size and shape, were found while excavating the site. Through precise use-wear trace analysis, two artifacts belonging to the missing category were identified (Giria and Pitul'ko 1993:33–36). Both were purposefully made for skinning and hide processing, respectively. The artifacts are made of fossil mammoth ivory. Massive ivory flakes struck off fossil mammoth tusks were detached along the longitudinal axis of tusks by a strong blow (Figure 42). One of the tools is identified as a skinning knife (Figure 42:2). It was secondarily retouched for to shape a handle. The traces of use-wear recognized on the surface cover the whole perimeter of the working edge of the knife blade as well as the lateral surfaces. The following are recognized: (1) smoothing of the working edge; (2) linear scratches oriented along the working edge; (3) fluid polishing that follows the micro relief of the flake surface.

Another one (Figure 42:1) is identified as a side scraper for hide processing. This is a large ivory flake lacking secondary retouch but with a series of small stepped scars and facets on the dorsal surface. The flake was probably struck off during the reshaping of some artifact (a pick?). The use-wear traces are identified as (1) smoothing of the working edge, (2) linear scratches oriented perpendicularly to the working edge, (3) intensive polishing of both the working edge and the adjacent surfaces.

Besides the use-wear traces, some marks emerged due to contact with the soil of the cultural layer. These were clearly recognizable on both the former and the latter, being markedly differ from traces of utilization.

During the site excavation, diverse flakes of ivory, bone, and antler were found besides those mentioned above. These obviously demonstrated permanent and intensive use of these raw materials and probably pointed to some standardization in methods of manufacture. Exactly the same methods can be found many millennia later in Eskimo sites that contained both the flaked artifacts of walrus tusk and the flakes.

## 3.7. Pickaxes of Mammoth Ivory and Antler

Twenty-eight implements, both fragmentary and whole, belonging to this category were excavated or collected from the surface (including two items presented to the Institute for the History of Material Culture by those who wintered over at the Zhokhov weather station in the 1970s). The frequencies of the finds suggest that fossil mammoth tusks and antlers were used equally. At least a part of the latter were collected by natives. The very characteristic stubs of antlers (the butts of dehorned antlers), used partially as clappers (see below), indicates that the dehorned antlers, as well as the antlers from wild animals, were used as a raw material.

Fifteen pick-like tools made of antler were found that vary in size and weight but share one style. The various beams and tines of an antler were used for this purpose. The diameter of the tools is 20 to 60 mm, the length 150 to 270 mm. Unused specimens indicate that the upper part of the tools did not exceed one-third of the total length and, therefore, it is possible that many of these tools were sharpened repeatedly. Thus some pick implements are disproportionate. Antler picks are usually 220 to 240 mm long. The sharpened working (distal) ends are wedge-like in profile, while the upper (proximal) parts are prepared for attachment to a handle or a shaft. Three ways of such preparation are recognized (Figures 43, 44).

Fewer pickaxes made of fossil mammoth ivory were found (13 items). Available fragments suggest that various parts of mammoth tusks were used. The largest fragment (the working part of some tool) is 268 mm long, though the implements are primarily 200 to 220 mm long and resemble the antler artifacts in some respects. The diameter of the used tusk stubs varies from 60 to 88 mm. The working (distal) ends are usually sharpened into a cone. The cone is, as a rule, somewhat aside the longitudinal axis of the tool (Figures 45:2; 46:2). Only one item has a wedge-like profile of the working end (Figure 46:1). The proximal ends of all the tools, except the last, are prepared for attachment to handles or shafts in the same style as was observed on the antler pickaxes. These tools, like the antler pickaxes mentioned above, were repeatedly sharpened. Thus the implements look disproportionate, and the working sections are of one-half to one-third of the total length of the artifacts.

Unfortunately, the surfaces of the tools are usually damaged, which makes it difficult to interpret their function. However, some of them have definite linear marks or scratches on the surface of the distal sections, which indicate contact with soil—perhaps due to digging. Inasmuch as such traces were found on both antler and mammoth artifacts, they could be interpreted in only one way. On the other hand, some tools are similar in morphology to the above-described artifacts that in fact have another function. Some of the antler pickaxes could be interpreted as strong bear-spear points (Figure 43:1). In all probability, one of the mammoth ivory pickaxes differs in function from other tools of this category, though it appears similar to them. This ivory artifact has a working section that is unilaterally convex, sub-triangular in profile without any signs of utilization (Figure 46:1). Perhaps it was never used, or might have been carefully reshaped. Such tools might be used as adzes for splitting the driftwood abundant at the Zhokhov Island site. It must be stressed that the wooden pieces saturating the cultural layer have numerous marks of artificial splitting, although the reason for this operation remains unclear. The wooden pieces discovered at the site could be waste fragments as well as the result of attempts to make the most efficient use of driftwood, which was probably rare near the site location.

## 3.8. Other Artifacts Made of Bone or Antler

Other bone or antler artifacts discovered at the site are represented by both finished artifacts whose function is clear and preforms or unfinished items. At the same time, there are also a couple of completely processed articles whose function is unclear.

Describing the artifacts making up the group, one should note the ground awl made of a thick piece of strong, massive bone. Its handle section and tipped point occupy about half of the total tool length. Both were shaped by grinding (Figure 40:2). This tool is 155 mm long, 11 mm wide, and 4 mm thick.

Antler handles for hafting stone adzes or chisels (?) are represented in the collection by nine items, two of them almost whole. They vary in size and have outlines resembling the letter L or T. The transverse brace has a flattened section or a cavity for attaching a stone tool; the end of the brace has a knobby bulge that was needed for locking the strip safely between the handle itself and the bulge (Figure 47). Both the beams and the tines were used for manufacturing these artifacts. The handles are 200 to 300 mm long.

Clappers were both excavated and collected from the surface (Figure 48:1–3). They are made primarily from the basal stubs of cut-off antlers; they total five items in various conditions of preservation. Such tools are typical for the Siberian Mesolithic and are found in some sites in South Siberia (Medvedev 1966). Their function is not quite clear. However, it is obvious that they cannot be interpreted as hammers since the traces of use wear observed do not correspond. Still, the working surfaces of these tools have definite marks of utilization indicating a percussive function. In my view, one can assume that these clappers were used for splitting or breaking up bones for various purposes, including cooking.

The function of some bone or antler artifacts among the finds remains unknown (Figures 48:6; 49; 50:1). Two of them are most interesting, especially since wooden artifacts were found that are completely analogous to them. A series of items are identical to each other in size, exterior details, and style of damages but made of different raw material—mammoth ivory (Figure 49:1), massive, solid bone (Figure 49:2), and wood (Figure 49:3, 4). They resemble unilaterally flattened handles with a knobby bulge on one end, while the other is cracked. The handles are undoubtedly fragments broken from some tools by a standard method. The fragments are not large, measuring 77 to 133 mm in length; the maximal width is 35 to 40 mm.

Also found were a series of four items made from distal epiphyses of reindeer metatarsal bones: the lateral sections of the articular surfaces were struck off, and V-shaped cavities were engraved at the center of the articular blocks (Figure 48:5). They are actually of the same size and represent completely processed artifacts, but their function is absolutely unclear.

## 3.9. Wooden Artifacts

A lot of artifacts made of wood were found besides the above-mentioned handles. These are dart and arrow shafts, a spoon, a fragment of a sledge runner, household equipment, and other artifacts of unclear function, both whole and fragmented.

***Arrow shafts***. Only ten fragments were excavated. They are of different lengths (Figure 51:5–8), and from 6 to 9 mm in diameter. It is very characteristic that Eskimos used arrow shafts of exactly the same diameter in historic times (Anderson 1970). The most interesting fragment has a wedge-like cavity engraved on the end made for hafting the point. The surface of the shaft has a section prepared especially for attaching the latter (Figure 51:8).

***Dart shafts*** (?) are much stronger and represented by fragments of different lengths. Only two pieces were found.

***Spoon***. A flattened spoon or cooking ladle, slightly curved in profile, is made from a thin sliver (Figure 51:3). Its bowl has a rounded outline. The handle is well processed and a little pointed. The artifact is 215 mm long (total). The length of handle is 75 mm; the blade is 55 mm wide.

***Household equipment***. Three fragments of wooden vessels were excavated (two more were collected on the surface); one of them has a hole drilled by the inhabitants of the site for refitting the cracked vessel (Figure 51:1, 2, 4). Six artifacts are preserved completely or in significant part (Figures 52–57). They differ markedly both in size and shape. No two vessels are of the same type. However, one can generally note that various wooden pieces were used to manufacture the vessels, and both the shape and the size strongly depended on that of the preform. Thus they are elongated owing to the form of pieces of soft, straight, and fine-grained types of wood chosen for making the vessels. Undoubtedly driftwood was used. The vessels have no definite typology but can be classified as follows: slightly deep with a handle or trays with no handle (Figure 52); scoops of different capacity (Figures 54, 57); and a bowl (Figure 53). Some of them are considerably long, up to 665 mm (Figure 57).

***Sledge runner.*** One of the most interesting artifacts excavated is a large fragment of sledge runner (Figures 26, 58) made of fine-grained, compact, hard wood. Probably a piece of larch was used for this purpose. It can easily be seen that the underside of the runner is finely polished by use and has distinct linear traces of rubbing. The working surface is clearly beveled from the external to the internal edge, which indicates that it is the left sledge runner. At 1,110 mm long, the fragment has the turned-up forepart with notches for the first cross-brace or the traction bow, where the running trace was attached and the sledge runners were fastened together with a sinew cord or rawhide strip. The turned-up section is 160 mm high and 200 mm long. From the distinct marks on the side surfaces, we can conclude that the runner was pressed into the snow cover to a shallow but constant depth (about 100–120 mm). Other elements of construction can also be described. The conically bored hole on the upper margin of the runner is a distance of 280 mm from the fore-end and has a maximal diameter of about 21 mm and a depth of about 15 mm. The purpose of the socket was to hold in place the sledge's frame—the first upright or a curved cross-brace supporting a freight platform. A small, narrow slit (10 mm wide) was cut from the upper surface to the inner side at a distance of 490 mm from the conical socket (Figure 58).

Also collected were a considerable number of worked wooden pieces of diverse forms. Their sizes vary. The largest is 1,050 mm long and 32 to 35 mm in diameter. Many of them have sections prepared for fastening together with other parts. Some of the numerous wooden artifacts are probably parts of the sledge's frame but are not clearly identifiable.

## 3.10. Faunal Remains and Seasonality at the Zhokhov Site

Preliminary information concerning the faunal remains excavated from the Zhokhov site was published earlier. It was noted there that most of the bones belong to polar bears and reindeer (Makeyev, Pitul'ko, and Kasparov 1992; Pitul'ko and Kasparov 1996). Other animals are very rare (Table 4). The minimal number for each is calculated according to the widely used method described by Sh. Bokonyi (1970), R. Chaplin (1971), and others. Animals were calculated on the left (or right) bones within categories. Size and age data were also taken into account when necessary and possible.

Special attention was paid to the main species, which were important food sources for the ancient natives of Zhokhov Island. The bones are often destroyed and some kind of damage is identical on others. This suggests a connection with the particular butchering methods. Ethnographic data confirm that it is possible to reconstruct the butchering practice used by hunters for cutting up prey. Some items (both bear and reindeer bones) have clear butchering marks. It is unlikely that the damages observed on the polar bear bones are enough to understand the

**Table 4. List of fauna remains from the Zhokhov Site (1989–1990).**

| | Species | Number of Bones | Number of Animals |
|---|---|---|---|
| **MAMMALS*** | | | |
| **Wolf** | (Canis lupus) | 3 | 1 |
| **Arctic fox** | (Alopex logopus) | 6 | 1 |
| **Polar bear** | (Ursus maritimus) | 397 | 21 |
| **Reindeer** | (Rangifer tarandus) | 450 | 20 |
| **Seal** | (Phocidae sp.) | 1 | 1 |
| **Walrus** | (Odobenus rosmarus) | 4 | 2 |
| **Dog** | (Canis familiaris) | 3 | 2 |
| **BIRDS**** | | | |
| **Tundra swan** | (Cygnus bewski) | 3 | 2 |
| **Goose** | (Ancer tabalis) | 19 | 6 |
| **Goose** | (Ancer albitrons) | 4 | 2 |
| **Sea-gull** | (Laridae sp.) | 1 | 1 |
| **Other birds** | (Aves sp.) | 4 | 3 |
| **TOTAL** | | 902 | |

* Identification by Aleksey Kasparov (RAS, Institute for the History of Material Culture)
**Identification by Olga Potapova (RAS, Institute for Zoology)

hunting methods practiced by the natives. Only one skull fragment, pierced by a strong sharp tool in the occipital region, can be pointed out. It was probably done during hunting; on the other hand, it might have happened after the animal was taken. In this connection we need to point out the specific artifacts that were previously discussed as equipment for digging (Pitul'ko 1993). Some of them have undamaged surfaces with clearly identifiable linear wear traces that confirm such a point of view. But could they have been re-utilized? The item in Figure 43:1, which has never been used in any function, looks strong enough to wound a bear and make the hole in the skull.

It has also been mentioned that bones of polar bears are extremely numerous at the site (Makeyev, Pitul'ko, and Kasparov 1992:302–303; Pitul'ko 1993:20). At the same time, fossil bones of polar bears occasionally discovered in Pleistocene or Holocene sediments are not numerous. Thus B. Kurten (1964) described only a few finds of polar bears in England and Sweden that dated to the Pleistocene and eight fossil bones from Sweden and Denmark belonging to Holocene sediments. The latter collection consists of one fragment from the lower left jaw and five fragments from postcranial bones of a polar bear.

The only bone of a Pleistocene polar bear (a left ulna) known from Russia was discovered on the Yamal Peninsula; on the Yamal and near the Kolyma River estuary were found some non-fossil polar bear skulls killed 200 to 300 years ago (Vereschagin 1969; Vereschagin and Tikhonov 1991).

The great number of polar bear bones emphasizes the unique character of the Zhokhov assemblage. A site where polar bears were the permanent food source for ancient hunters is discovered for the first time. The bones of polar bears dug out of the few Arctic sites are not numerous or are absent. For example, we note two skulls and some postcranial bones of polar bears excavated from the Eskimo site at Cape Baranov near the Kolyma River estuary and dated between AD 1000 and 1600 (Okladnikov and Beregovaya 1971; Vereschagin 1971). The ratio of the paleozoological materials from Walakpa site (Alaska, Bering Strait area) is more graphic: excavated there were 9,477 bones of seals, 6,076 reindeer bones, 236 bones of domesticated dogs, and 172 bones of polar foxes, but there were only 37 bones of polar bears from all horizons (Stanford 1976).

Though the bones from Cape Baranov have specific cooking marks (Vereschagin 1971), they are not evidence of the constant polar bear hunting. Nevertheless, these strong and dangerous animals were common prey for the ancient natives of Zhokhov Island.

## Polar Bears (*Ursus maritimus*)

As mentioned above, the bones of polar bears are very numerous at the Zhokhov site (Table 4), and both the cranial and the postcranial bones are examined (Tables 5, 6; Figures 59, 60). Skull (cranium) fragments are rather numerous among the bones. They are:

1. fragments of the frontal section of the upper jaws, often with fangs and incisors—19.6% of cranial fragments;
2. skull fragments with the molar and premolar line and a section of palate; sometimes a piece of cheek bone—25.0%;
3. fractured frontal bones with supraorbital processes—19.6%;
4. fragments of parietal bones (as a rule, the extensive fragments of parietal bone are joined to the upper section of the occipital bone); the parietal bones are often joined along the natural central commissures—17.8%;
5. fractured temporal bones with small sections of the cheek bones and the articular surfaces for the condyles of the mandibles—10.7%.

The enumerated fragments resulted from the destruction of skulls, and it can easily be seen that the natives repeatedly used the same methods to break down the skulls of polar bears. The process included several operations; the directions for destruction are shown in Figure 59 (the totally crushed zones are cross-shaded). Besides these fragments, there are two skulls in the collection where the operation of dismembering was not completed.

***Skull 1***. The facial part is practically absent: it was broken off along line $Pm_2$–$Pm_3$ on the right, but the cheek bone is undamaged and a fragment of temporal bone is intact. On the left, the facial part of the skull was completely destroyed, including the cheek bone and the supraorbital process. The vault with the saggital crest and the sphenoid bone of the skull are intact, though the laterals of the parietal bone and the upper section of the temporal bone are broken off. The occipital bone with the condylus and the spinal cord hole are not damaged. Evidently, the bones were crushed by piercing extensive holes from the lateral side of the brain case.

***Skull 2*** was broken down by the same method, but the facial part is well preserved. The cheek bones and the vault are absent. The occipital bone is slightly damaged (the left condylus is broken off). The skull cup is broken. This was done by piercing an opening from the lateral side, as in the first skull.

**Table 5. Some parameters measured on polar bear skulls (1–16) and mandibles (17–26) from the Zhokhov Island site, in comparison with data on modern polar bears of the New Siberian Islands (after V. V. Pitul'ko and A. K. Kasparov, 1996).**

| | | Zhokhov Island (Early Holocene) | | New Siberian Islands (modern)*, N=7 | | |
|---|---|---|---|---|---|---|
| | **Measurements** | **N** | **LIM** | **M** | **males (?)** | **females (?)** |
| | CRANIUM | | | | | |
| 1. | Condylobasal length | 1 | – | 320[1] | 368.4 | 327.6 |
| 2. | Basal length | 1 | – | 300[1] | 338.4 | 301.4 |
| 3. | Breadth of the canine alveoli | 2 | 77.7[1]; 93.0 | 85.4 | 92.4 | 77.2 |
| 4. | Least palatal breadth: measured behind the canines | 1 | – | 80.0[1] | – | – |
| 5. | Breadth at postorbital constriction | 2 | 67[1]; 73.7[2] | 70.4 | – | – |
| 6. | Facial length: Frontal midpoint—Prosthion | 1 | – | 63.1[1] | – | – |
| 7. | Upper neurocranium length: Akrokranion—Frontal midpoint | 2 | 180[1]; 196.6[2] | 188.3 | – | – |
| 8. | Breadth of the choanes | 2 | 18.7[1]; 16.6[2] | 17.7 | – | – |
| 9. | Greatest breadth of the occipital condylus | 3 | 71.3[2]–82.5 | 78.1 | – | – |
| 10. | Alveolar length of cheek tooth row: measured on the buccal side from oral border of the canine alveoli | 5 | 111.8–140.0 | 124.8 | 150.4 | 135.8 |
| 11. | Length of the molar row along the alveoli | 9 | 63.4–82.5 | 69.8 | – | – |
| 12. | Length of $M_1$ crown | 18 | 21.0–30.5 | 25.2 | – | – |
| 13. | Alveolar length of $M_1$ | 17 | 21.8–36.1 | 26.9 | – | – |
| 14. | Greatest breadth of $M_1$ | 2 | 112.8–15.4 | 14.0 | – | – |
| 15. | Basal length of canine crown | 4 | 17.5–21.4 | 20.2 | – | – |
| 16. | Breadth of canine crown | 4 | 13.6–15.0 | 14.4 | – | – |
| | MANDIBLE | | | | | |
| 17. | Total length: condyle process—Intradental | 3 | 233.0–268.0 | 230.5 | 251.0 | 220.8 |
| 18. | Alveolar length of cheek tooth row: from oral border of the canine alveoli | 12 | 125.8–160.3 | 137.9 | 149.6 | 135.4 |
| 19. | Crown length of the molar row | 5 | 66.4–74.7 | 70.0 | – | – |
| 20. | Alveolar length of the molar row | 22 | 66.3–76.5 | 69.4 | – | – |
| 21. | Length of $Pm_4$ crown | 18 | 19.0–22.0 | 20.4 | – | – |
| 22. | Length of $M_1$ crown | 21 | 18.6–21.6 | 19.9 | – | – |
| 23. | Greatest breadth of $M_1$ crown | 20 | 10.1–11.4 | 10.8 | – | – |
| 24. | Height of the mandible behind $Pm_4$ measured on the lingual side | 20 | 36.0–57.3 | 41.8 | – | – |
| 25. | Basal length of canine crown | 12 | 18.5–26.0 | 20.8 | – | – |
| 26. | Breadth of canine crown | 10 | 13.1–17.0 | 14.4 | – | – |

Notes
After F. B. Chernyavsky (1969).
[1] Measurements taken from Skull 1.
[2] Measurements taken from Skull 2.

Comparing the dimensions of the fossils from the Zhokhov site with the modern skulls of polar bears from the New Siberian Islands described by F. Chernyavsky (1969:54–67), one can conclude that both the fossil and the modern skulls have no sharp differences in morphology. Accordingly we can judge that Skull 2 belongs to a female, while the other (Skull 1), more poorly preserved but with approximately the same dimensions, possibly also belongs to a female.

The average dimensions of the fossil skulls appear smaller than those of modern male animals (Table 5). The average data are close to those for modern female bears. Perhaps specific hunting practices might explain it; females with cubs might have been killed more often since they would be more vulnerable. It is well known that modern hunters shoot both females with cubs and old male animals that inconvenience people. Besides, female bears visit the Arctic coast or high Arctic islands, where they look for a place to give birth to their cubs. The ancient Arctic hunters of Zhokhov Island were evidently able to kill them at this time.

The parameters of the dental system of polar bears from the Zhokhov site have no strong differences from data obtained by Kurten (1964) on Late Pleistocene fossils from the Göteborg Museum (Sweden). The total skull length of the Pleistocene female is equal to the modern and the Early Holocene items from Zhokhov Island as well. Those of Zhokhov Island differ slightly from Pleistocene fossils. Both have the same width, but the length of $M_1$ measured on the skulls from Zhokhov Island is larger. The same proportions are typical of modern polar bears.

In summary, the morphology of the polar bears killed ca. 8000 BP on Zhokhov Island appears very similar to that of modern polar bears that typically inhabit the region of the New Siberian Islands.

Mandibles *(Mandibula)*, both intact and fragmented, are abundant in the collection (Figure 60; Table 5). They are broken primarily by specific methods near the location of the coronoid processes.

Sections of the coronoid process are broken from 33 mandibles having well-preserved dental lines, while 18 pieces are from the back of the mandible. The coronoid process with articular condylus are present, but the largest part of the mandibles is broken off. Two kinds of damage are noted: (1) the front and/or upper edges of the coronoid sections of the mandibles are chipped slightly or broken off entirely (12 items); (2) the articular condyli are broken from nine bones. The dimensions indicate that the animals were of mid-size (Table 5) and probably female.

The characteristics examined on the fragments of skulls and mandibles of polar bears make it possible to advance some conclusions about the operations used for skull destruction. Unfortunately, it is difficult to understand the succession of the operations; moreover, no one can confirm that any succession took place at all. But the great quantities of standard fragments of skulls and mandibles confirm that a specific operation was used regularly, and some suppositions may be advanced.

Evidently the initial operation of cutting up the killed animals was carried out at the kill site. The head was removed from the carcass after skinning. The method of this operation has not been identified since cervical vertebrae are rare in the collection. The occipital condyli of the skulls and atlases are usually intact. Either the head was carefully cut from the spinal column or, more probably, the spinal column was chopped near the second vertebra. Thus the latter was destroyed almost completely and the fragments were left somewhere beyond the living site.

After carcass parts were brought to the site, dismemberment was continued. Some procedures are identified for cutting up the heads of polar bears (Figure 59):

1. The protruding parts of the muzzles were broken off, evidently to extract the canines. The latter were probably valuable for the hunters as adornments or talismans. It is interesting to note that bear fangs are numerous among teeth found separately from jaws (more than 30%).
2. For the mandible and strong masticator muscles to be dismembered, the cheek bones were destroyed near the middle. During this operation the coronoid process of the mandibles was chipped, while the mandibles were broken in two. The probable secondary purpose of such action was to extract the tongue.
3. Then, for extraction of the brain, holes were pierced in the sides of the skulls. The actions were not careful and the skulls were broken into several parts (frontal, occipital, and temporal bones). Evidently during this process sections of cheek and temporal bones were destroyed to a great extent, and the characteristic marks appeared. The temporal sections of the skulls were chosen for striking because the thickness of the skull on the point at the juncture of the frontal, parietal, and temporal bones is extremely small (only half a millimeter) and this section of skull is very durable.

These procedures were in practice for a long time. Thus two skulls excavated from the Eskimo settlement at Cape Baranov and dated to later than the Zhokhov site—between AD 1000 and 1400—were broken in the same way. Both have holes pierced in the sides and the cheek bones broken off, though the ends of the muzzles are intact. The lateral holes are not as extensive as the holes in the skulls from the Zhokhov site; the diameter of the openings varies from 7 to 10 cm, i.e., the skulls were little damaged in comparison with the Zhokhov finds (Vereschagin 1969).

It should be noted that the bear skulls collected by N.K. Vereschagin from the Nenets sacrificial sites on the Yamal Peninsula and dating from the beginning of 14$^{th}$ century AD or later have almost no traces of damage at all. Thus the lateral bones were pierced on only three of 58 skulls collected. As a rule, the cheek bones are intact. The fangs were extracted from 35% of the skulls. Evidently, we can assume that the custom of total destruction of polar bear skulls was gradually vanishing.

The atlas *(Atlas)* and other vertebrae are rare in the collection (Figure 60). Atlases are well preserved as a rule, 10 of them have both ventral and dorsal arcs; the articular surfaces are mainly undamaged although four bones have marks of striking. Only two items have seriously damaged frontal articular surfaces. No fewer than half of the lateral processes of the atlases are broken off; some have no lateral processes at all. Nevertheless, we suggest that the latter defects are not connected to human activity. Other sections of the bear's spinal column are rare in the collection: there are only three fragments of the facial part of the axis and two ventral arcs of lumbar vertebrae, which had been gnawed by dogs.

Shoulder blades *(Scapula)* are also not numerous (Figure 60). All of them are fragmented.

Three fragments are from very large animals; the others belong to mid-size bears. The bones are poorly preserved. Only five items have intact or lightly damaged articular surfaces. The others are forepart fragments of shoulder blades—the neck of the scapula with the beginning of the shoulder crest, at the caracoid process, are always broken off. The crests are always extremely damaged on the external edges. Consequently we can assume that the destruction of shoulder articulations took place during dismembering of the humerus bones. We should note that proximal humeri are nearly absent in the collection, and only one proximal fragment was found. Some dimensions were measured (Table 6).

Humeri *(Humerus)* are abundant in the collection (Table 6; Figure 60). As mentioned earlier, a single scorched fragment of a proximal articular head was found. The others are the distal ends (section of diaphyses with distal epiphyses). The fragments are not large in size. The length of the fragments is no more than one-quarter or one-third of the normal length of intact humeri. Most of the bones, except one item, are badly damaged. The articular blocks are usually crushed, and only three bones have the medial section of the articular surfaces. Most of the items have clear traces of canine gnawing. Since this is true not just for this category, we have to explain such a conclusion. Of course, we cannot state unequivocally that each bone with chewing marks was gnawed by a dog. But at the same time, the teeth marks (their size and especially the distance between fang marks) indicate that marks on bones gnawed by a carnivore are significantly larger than those of an Arctic fox. It is possible that it might have been a small wolf, but we tend to suppose that it was a dog since dog bones were discovered at the site (see above). At the same time we need to point out that the chewing activity of a dog (or other carnivore) did not substantially affect the preservation of the bones. It should be pointed out that there are no items where the surfaces or articulations were terminated by chewing activity.

The ulnae *(Ulna)* are numerous (Figure 60). As a rule, they are seriously damaged. Two parameters were measured (Table 6). Damages clearly indicate the operations used for cutting.

**Table 6. Measurements on postcranial skeletons of fossil polar bears from the Zhokhov site by category (after V.V. Pitul'ko and A.K. Kasparov, 1996).**

| DIMENSIONS | N | LIM | M |
|---|---|---|---|
| SCAPULA | | | |
| Articular length | 3 | 60.5–74.0 | 68.7 |
| Articular breadth | 6 | 32.4–50.6 | 38.9 |
| HUMERUS (distals) | | | |
| Greatest length | 2 | 103.6; 107.0 | 105.3 |
| Articular breadth | 4 | 65.4–89.5 | 74.5 |
| Diameter of mid-narrowing of articular block | 9 | 22.8–33.0 | 25.9 |
| ULNA (proximals) | | | |
| Greatest articular length: at the external border of olecranon | 12 | 65.1–90.1 | 72.0 |
| Greatest articular breadth | 16 | 54.5–71.6 | 59.6 |
| RADIUS | | | |
| Frontal diameter | 2 | 30.9; 41.0 | – |
| Transversal diameter | 2 | 43.5; 55.2 | – |

Thus, the distal sections of bones are usually broken off: there are 40 items without distal sections (about one-third the normal length of the bones is lost) and only two distal fragments of ulnae. Besides these items are seven proximal fragments with the articular part and eight fragments of diaphyses. Most of the bones are proximals having very specific damages: the olecranons are much damaged near the articular surfaces or completely broken off together with the latter. Only five ulnae have intact olecranons. The damages are undoubtedly butchering marks and their regular character confirms it. The described indications show that, as a rule, the forelegs were chopped off, usually unbent at the elbow joint. The blows were struck at the junctions of the articular parts of the humeri and the olecranon of the ulnae was destroyed as described above. But sometimes forelegs were not unbent before the chopping and another feature of damage appeared—only the upper sections of the olecranons were broken off. Evidently the absence of distal humeri shows that the metacarpal parts of the legs, of little value as a food source and causing a heavy load, were chopped off before the prey was transported to the living site. Thus these bones might be abundant at kill sites.

Radial bones *(Radius)* are few in number (Figure 60) and much fragmented. There are five proximal fragments, only one distal fragment, and two pieces of diaphyses. This can also probably be explained by butchering at the kill sites. Though the radial bones are fragmented, some dimensions were measured (Table 6).

Fragments of pelvises *(Coxae)*, femurs *(Femur)*, and tibiae *(Tibia)* are extremely rare in the collection (Figure 60). No regularity of destruction was observed. It could be noted, however, that the pelvic bones are represented only by fragments of the pelvic joint cavity and the tibiae by distal fragments. Some items (primarily femur fragments) have clear marks of canine gnawing. At the same time, the quantity of fibulae *(Fibula)* is unexpectedly large (Figure 60), but they are diaphyses. Only two epiphyses were found (proximal and distal).

The heel bones *(Calcaneous)* are not abundant (Figure 60). All of the bones are damaged: the rear section of the bones is broken off, and it looks like the heel bones were chopped in the middle. The external surfaces are definitely damaged; the others are much gnawed by dogs, and identification of cut marks is impossible. We assume that the damages appeared as a result of chopping off the lower parts of hind legs. However, the operation took place at the living site since both the distal bones of the heel and the chopped parts were found. Evidently the Achilles tendons, which fastened to the rear parts of the heel, were cut along with the latter.

The ankle bones *(Astragalus)* are fragmented and extremely rare (Figure 60). Metatarsals and metacarpals *(Metapod)* are also few in number. Both the first and the second were damaged by the distal epiphyses being broken off. All of them are much gnawed by dogs. Phalanges *(Phalanx)* are numerous (Figure 60). There are 20 front and 14 rear phalanges I, 13 front and 10 rear phalanges II, and 9 front and 6 rear claw phalanges. Some observations are in order. Phalanges I are generally intact; the surfaces of some bones seem slightly dissolved by canine (?) gastric juices—evidently the bones were gulped down by dogs. Phalanges II are intact and have the marks of canine gastric juices also. The claw phalanges are not damaged; one bone has a well-preserved claw. As an indication of the age of the animals that were killed by Zhokhov natives, we can point out that the rear phalanges II (1 item) and the rear claw phalanges (1 item) with sclerotic excrescences belonged to a very old polar bear.

Keeping in mind that phalanges are the most numerous bones (along with ribs and vertebrae) of the skeletons of predators, the quantity of collected phalanges is admittedly extremely insignificant. Probably, as mentioned above, the small quantity of phalanges at the site was determined by the initial butchering of killed bears at the kill sites, where the lower parts of legs were chopped off and abandoned. The latter were rarely brought to the living site: for example, if a bear was taken nearby or directly at the site location.

As can easily be seen from diagrams (Figures 60, 61), the fragments of cranial bones were extremely abundant in the excavated area. The atlases are also numerous. Distal humeri and proximal ulnae are the next most abundant. The diagrams (Figure 60) show that the bones from the front parts of carcasses prevail among the bone remains of polar bears.

This can probably be determined indirectly by assuming that the primary butchering of taken animals was at the kill location. Hunters used the following operations: they skinned the bear and then dismembered the carcass into several portions rich in meat; then they cut off the legs and head. To make transportation of the prey easier, they chopped off and abandoned some inedible sections (for example, the lower parts of paws). Butchering was finished at the camp, where hunters chopped off the legs at the knee or elbow joints. Concerning the latter, it can be said that the operation was carried out after straightening the paw. The skulls were broken down entirely for extraction of the brain and the tongue. The canines were probably also of some value. Surprisingly, the bones of the front part of the bear skeleton predominate at the site. The ancient hunters of Zhokhov Island were undoubtedly able to bring to the site both the front and hind paws of the bear, but we have no evidence of the latter—probably due to the small excavated area of the site. But specific features of the spatial distribution of bones still remain unidentified. At the same time, some observations on the spatial distribution of reindeer bones tend to support this idea. For example, locations abundant with skull fragments were discovered, but there were places without or with an extremely small number of them, yet the shoulder blades (e.g., metatarsal bones) were abundant. At some localities bones were entirely absent.

Consequently, it can be assumed that the missing bones of polar bears might be concentrated somewhere in the unexcavated area of the site. The indirect cause of this might also be connected with primary butchering away from the site.

## Reindeer (*Rangifer tarandus*)

The second food source used by Zhokhov Island hunters was traditional to all Northern peoples: the cultural layer of the site was very rich in the bone remains of reindeer (Table 4; Figure 61).

The skulls *(Cranium)* are always fragmented. Most abundant are the antlers (115 items). Fourteen of them retain pieces of frontal skull bones; the others are only broken antlers. About 30% belonged to does and young deer (in general, the section of antler directly exiting the skull). But 15 fragments are from large reindeer; 10 fragments are from the mid-part of the antler shafts, and the others are fragments of upper tines. Most of the antlers are chaotically fractured, although some of them were cut or chopped around before breaking.

Skulls and upper jaws (only 18 items) are much fragmented and any measurements are impossible. The small quantity of skull fragments seems strange in comparison with the abundance of antler fragments. However, observations by Binford and Bertram (1977) show that the Eskimos of northern Alaska only rarely use caribou heads as a food source. They kill a large number of caribou during migrations and then preserve the meat by freezing it in pits dug into permafrost or by making jerky by drying it on stands near the houses. Unfit for jerking, the heads were rarely preserved by freezing; usually these parts of caribou carcasses are fed to dogs. A large number of heads with antlers are piled over meat pits so that the antlers stick out of the snow, marking the place.

Evidently, the hunters of Zhokhov Island did not use reindeer heads as food either, inasmuch as an abundance of meat was standard during the period of reindeer hunting. But in contrast to modern American Eskimos, who are well equipped with a variety of goods, the prehistoric natives of the De Long Islands needed bone raw material for manufacturing different equipment. There is much evidence of the use of reindeer antlers and bones for tool making (see above). Thus antlers were brought more often than unbroken reindeer heads to the living site. Moreover, it must be emphasized that the statistics of broken antlers may misrepresent the facts since the fragments might result from more than one breaking of the antlers. It must be noted that naturally lost antlers were used as well.

Reindeer mandibles *(Mandibula)* are very abundant (Table 7; Figure 61) and extremely informative since the examination of teeth gives a chance to define the season when the reindeer were taken. There are 26 fragments of young or sub-adult animals, where the replacement of milk teeth was not yet complete. No jaws of old animals were identified.

The damages to mandibles are of a specific and regular character; a kind of standardization of damages is identified both for reindeer and bear mandibles in general. Mandibles with a complete line of teeth are abundant—22 items, each without coronoid process and articular condyli, which are rarely found separately. Only two mandibles do not have the latter broken off. Evidently the mandibles were crushed by hard blows for removal from the skulls and forobtaining the tongue. Most of the mandibles are broken in half. The fracture is always located near

**Table 7. Parameters measured on fossil reindeer mandibles from the Zhokhov site (after V.V. Pitul'ko and A.K. Kasparov, 1996).**

| | VALUE | | |
|---|---|---|---|
| DIMENSIONS | N | LIM | M |
| Length of the molar row along the alveoli | 8 | 91.0–103.0 | 95.5 |
| Crown length of the premolar row | 11 | 37.7–44.1 | 40.7 |
| Crown length of the molar row | 12 | 55.0–62.4 | 57.3 |
| Distance from the rear border of the nutrient hole to the front border of $P_2$ alveoli | 10 | 42.7–52.7 | 47.4 |
| Crown length of $M_3$ | 13 | 20.2–25.5 | 22.2 |
| Height of the mandibles: $P_4$–$M_1$ | 2 | 28.1; 25.0 | 26.6 |

the line of $M_1$ or $P_4$–$M_1$. The lower part of each mandible is broken off or seriously damaged. Such operations were necessary to reach the cavity rich in marrow and blood vessels. The incisor zone of the mandibles is usually damaged (except in four items). The alveoli are extremely crushed or broken off together with an extensive section of diastemus. L.R. Binford, describing methods of butchering among the Caribou Eskimos, notes that the custom of careful dismembering of the heads of killed caribou and especially the same methods of extracting the caribou tongue were known by Alaskan natives beginning in the Late Paleolithic (Binford 1981). It is very significant that fragments of reindeer mandibles from the Mousterian layers of the Comb Grenal site in Europe, published by Binford in comparison with the Alaska finds, were broken near the position $M_1$, i.e., the same method was used. But in contrast to the Zhokhov finds, the mandibles from Comb Grenal have marks of striking inside on the line $M_2$. Nevertheless, the general operation used for breaking reindeer mandibles by both the Zhokhov natives and the Mousterians at Comb Grenal were similar to each other—differing only in a few details.

Examination of the reindeer mandibles allows proposing assumptions about the seasonality of the Zhokhov site. To provide grounds for these, we examined the mandibles of the sub-adult animals. Inasmuch as the calving of reindeer takes place from May to June, the starting point for the chronology is well known. The examination of the reindeer dental system shows that a lot of animals were killed during one period: 26 mandibles of semi-adult reindeer were examined, of which 13 either have the third and fourth milk teeth coming out or have already come out. The second and the third premolars (and sometimes the third molar) of these mandibles are erupting. Such a situation is typical for reindeer during the third year of life. There are also two mandibles of very young animals with $M_1$ teeth erupting. The appearance of the latter is also typical for the beginning of the summer period, but it takes place in the first year of life. Inasmuch as three fragments of mandibles with erupting $M_2$ teeth were found, it can be assumed that some animals were killed in the first half of summer.

Finally, several fragments with teeth indicate another season of killing. Thus the upper surfaces of the $M_2$ teeth examined on three fractured mandibles are worn off, while the $M_3$ teeth have not erupted at all. The eruption of $M_2$ teeth is almost complete on three other specimens. The described indications of dentition are typical for reindeer from August to October and may be observed respectively in the second and third years of life.

Most subadult animals were killed in spring or early summer, i.e., during the period of spring migration. In fact, reindeer are rarely taken in fall. But it does not mean that spring hunting was more effective than an autumn one. In all probability, the conclusion advanced is correct not only for young animals. The elicited facts confirm the well-known tradition of killing reindeer during their seasonal migrations, which is generally practiced among Arctic peoples as the basis of the subsistence economy.

The postcranial bones of reindeer are also abundant, but some categories (especially the vertebrae) are scarce (Figure 61). One fragmented and two intact atlases *(Atlas)* were collected. Because both of the intact items are damaged, they were measured in two positions (Table 8). Only one fragment with an undamaged frontal part of the articular surface of the axis *(Epistro-*

**Table 8. Parameters measured on reindeer postcranial bones from the Zhokhov site (after V.V. Pitul'ko and A.K. Kasparov, 1996).**

| DIMENSIONS | VALUE | | | | | |
|---|---|---|---|---|---|---|
| | N | | LIM | | M | |
| ATLAS | | | | | | |
| Frontal articular breadth | 2 | | 64.8; 73.0 | | 68.90 | |
| Ventral length | 5 | | 39.0–47.6 | | 44.50 | |
| SCAPULA | | | | | | |
| Ventral angle length | 6 | | 31.2–40.5 | | 35.00 | |
| Articular length | 7 | | 23.6–39.4 | | 30.20 | |
| Anterior-posterior length | 4 | | 24.0–33.5 | | 28.60 | |
| HUMERUS (distal) | | | | | | |
| Greatest breadth | 20 | | 41.2–52.3 | | 47.00 | |
| Total articular breadth | 22 | | 37.7–48.0 | | 43.7 | |
| Middle articular diameter | 25 | | 23.2–30.0 | | 24.70 | |
| Breadth of diaphisis | 7 | | 20.2–25.3 | | 22.30 | |
| ULNA (proximal) | | | | | | |
| Greatest articular height | 10 | | 35.0–45.0 | | 38.50 | |
| Greatest breadth | 13 | | 22.6–28.8 | | 26.20 | |
| RADIUS | | | | | | |
| Total proximal breadth | 12 | | 42.7–51.3 | | 47.80 | |
| Breadth of proximal articular surface | 13 | | 40.8–47.5 | | 44.20 | |
| Ant.-post. diameter (proximal) | 13 | | 24.5–30.2 | | 27.20 | |
| Breadth of diaphyses at mid-section | 9 | | 21.8–34.0 | | 26.90 | |
| Total distal breadth | 15 | | 40.0–49.5 | | 43.90 | |
| Ant.-post. articular diameter (distal) | 16 | | 25.6–34.2 | | 28.50 | |
| TIBIAE (distal) | | | | | | |
| Total breadth | 14 | | 38.0–45.5 | | 41.60 | |
| Ant.-post. diameter | 17 | | 24.5–37.0 | | 33.4 | |
| Breadth of diaphyses at mid-section | 4 | | 20.8–32.0 | | 26.4 | |
| ASTRAGALUS | | | | | | |
| Total lateral length | 13 | | 43.0–50.5 | | 46.6 | |
| Upper articular breadth | 14 | | 23.1–27.8 | | 25.4 | |
| Bottom articular breadth | 13 | | 26.6–33.1 | | 29.00 | |
| CALCANEUS | | | | | | |
| Greatest articular breadth (frontal) | 12 | | 24.7–32.4 | | 27.2 | |
| Greatest height of rostrum | 10 | | 32.2–36.8 | | 35.20 | |
| METACARP (*) / METATARS (**) | * | ** | * | ** | * | ** |
| Total length | 5 | – | 196.6–304.2 | – | 225.3 | – |
| Greatest proximal breadth | 23 | 4 | 31.7–40.0 | 29.0–35.8 | 35.2 | 32.5 |
| Proximal ant.-post. breadth | 18 | 2 | 23.0–29.5 | 32.1; 36.6 | 25.9 | – |
| Breadth of diaphyses at mid-section | 20 | 13 | 17.8–29.0 | 18.3–26.4 | 22.3 | 21.9 |
| Greatest distal breadth | 23 | 31 | 37.6–48.6 | 38.1–46.5 | 42.1 | 42.6 |
| Ant.-post. articular diameter (distal) | 25 | 29 | 20.1–25.0 | 21.1–26.5 | 22.3 | 24.7 |

*pheus)* was found; it is 64.4 mm wide. Besides these bones, two broken lumbar and one fragment of sacrum vertebra were excavated. To sum up, both reindeer and polar bear vertebrae are extremely rare in the collection. Evidently, it is not accidental and may have been affected by the general strategy or procedures of butchering that were in practice.

In contrast to the bones completing the spinal column, the shoulder blades *(Scapula)* of reindeer are rather numerous (Table 8; Figure 61). All of the bones are broken and 23 items are fragments of scapula necks with the articular surfaces. The latter are intact or damaged slightly on 13 items; 8 bones have damage on the upper section of the articular surface, which is broken off on two items. The scapula neck with articular surfaces is completely terminated on 13 bones.

The crests of the shoulder blades are damaged except on two bones. These sections are chopped off on seven shoulder blades. Only six items have intact or lightly damaged crests. Generally, the middle sections of shoulder blades are broken out on most items. At least one shoulder blade was pierced from the ventral surface.

Though Binford (1981) notes that the destruction of suproglenoid tuberals and coracoid processes generally indicates the gnawing of bones by dogs (or wolves), it is evident that such damage observed on bones from the Zhokhov collection is undoubtedly the result of human activity since gnawing marks were identified on only three fragments. In general, shoulder blades are crudely fractured. The damage is of an unmethodical character. The articular sections were damaged or broken off together with the procedure of breaking a shoulder joint.

All of the collected shoulder bones *(Humerus)* are distinctly fragmented (Table 8). There are only distal fragments of humeri; no more than the distal third of the diaphyses are preserved. The distals are intact or lightly fragmented on 25 bones; five items were greatly damaged. The rest of the shoulder bones (11 items) are distal fragments of diaphyses, sometimes split lengthwise. But what is important is that the proximal sections of humeri were not found at all.

Such disproportion within the categories of osteological materials (for example, the proximal/distal ratio) looks standard for archaeozoological materials. It is well known that distal humeral fragments of diverse ungulates excavated from sites dating to different times and located in different regions are more abundant then proximals. Thus, the quantity of distal fragments of caribou humeri regularly prevails over the proximals. The same was noted for bones from the Mousterian Comb Grenal site in France, where the osteological materials comprise reindeer, horse, and prehistoric bos remains (Binford 1977, 1981). Exactly the same was revealed on bone remains of domestic sheep and goats excavated from Neolithic and Eneolithic sites in Turkmenistan (Kasparov 1989), where the number of distal epiphyses extremely outnumbered the proximals.

Finishing the description of shoulder bones, we note that both the described disproportions and the specific damages on reindeer humeri are determined by the dismembering of forelegs and shoulder blades, when the humeral proximals were lost. After the dismembering, the diaphyses of the reindeer humeri were broken unsystematically by the Zhokhov natives for the marrow to be extracted. Some bones were split lengthwise.

There are few ulna bones *(Ulna)* (Table 8; Figure 61). Only 13 proximal fragments were found.

The olecranon processes on bones are always damaged; the upper part of the articular surface is broken off on one item. The others have either an intact or a slightly damaged articular surface.

In contrast to the ulnae, the radii *(Radius)* are abundant in the collection (Table 8; Figure 61). Some of them are attached to lower sections of ulnae. There are 17 proximals and 22 distals. An intact ulna-radius juncture, or just the upper part of the latter, was not found. The radii are broken off at a distance of 10 to 12 cm from the proximal articular surface, which is not usually damaged. It is interesting that the ulnae described above are fractured just there. But in contrast to the proximals, the distals are split or cracked lengthwise. The distal fragments are usually about 10 cm long and look like long bone slivers. The described specific damages indicate that the lower section of the bone (about one third of the normal length) was chopped off for extracting marrow. This section is accessible for breaking because the ulna attaches to the radius here and does not rise over the latter.

Pelvis bones *(Coxae)* are much fragmented and rare (Figure 61). Besides five fragments of pelvis bones and four intact joint cavities, there are fragments of iliac bones. The fragments have no specific dimensions or outlines, and the pelvis bones were evidently broken without any standard process. Femur bones (*Femur*) are also especially rare (three fragments—two articular heads and one distal epiphysis).

The tibiae *(Tibiae)* are represented by 21 distal fragments (Table 8; Figure 61). The distals are almost completely undamaged and usually have a 4 to 6 cm long section of diaphyses—17 items. The fracturing is similar to the marks observed on the radii. Evidently these bones were also broken for the extraction of marrow. However, the extremely small fragments of diaphyses are a doubtless result of damage to the ankle joint (see below).

Ankle bones *(Astragalus)* are few in number (Table 8; Figure 61). Most of them are intact; two bones were gnawed by dogs. The latter is unusual for reindeer bones excavated from the Zhokhov site.

Heel bones *(Calcaneus)* are also not abundant (Table 8; Figure 61). They are broken in one way: the rear sections of the bones (where the bone and the strong tendon straightening the talocrural joint are attached) were broken off 13 items. Others (two items) are damaged more extensively and look like small fragments of the articular surface with the rostrum. It should be said that six fragments have been gnawed a little. Keeping in mind the regular character of damage, we can assume that the ankle joints were dismembered by the slashing of the tendons of the powerful muscles holding the joints. The rear parts of heel bones were broken off together with the tibiae distals. The greatest frontal width of the articular surface and the greatest rostrum height were measured (Table 8).

The metacarpal *(Metacarp)* bones are abundant (Table 8; Figure 61). Both proximal (67) and distal fragments (39) were found, and six fragments of diaphyses were dug up as well. The damages on the proximals are of a random unmethodical character (Figure 17), while the distals are always intact. Most of the distals are no longer than 10 cm; longer fragments (about 20 cm long) are rare (seven items). Evidently the breaking of the metacarpal bones was transverse, but sometimes they were split lengthwise by striking on the proximal ends.

Metatarsals *(Metatars)* are also numerous (Table 8; Figure 61). They are always fragmented, and both proximals (19) and distals (31) were found. All of the proximals (except two items) are broken, but the breaking is irregular. Both the distal and the proximal fragments are rather long (10 to 20 cm), though very short fragments were also collected. The character of the damages evident on the metatarsals indicates that the principal idea of the fracturing, in contrast to the metacarpals, was the splitting of bones from the proximal ends. Only two metatarsals were broken by striking on the middle section of the diaphyses.

It should be noted that there are metatarsal or metacarpal fragments that cannot be defined (long strips of bone). On the one hand, it may be assumed that metacarpals and metatarsals were split for extracting marrow. On the other, the elongate and sharp bone strips were excellent raw material for making such things as awls, needles, and hunting equipment. Artifacts made in this way are known from as early as the Iron Age. Even in the ancient states of the Black Sea region bone carving was based on the use of metacarpal and metatarsal bones of ungulates (Peters 1986).

Bones in the phalanx (*Phalanges*) category are rare. Phalanx I are the most numerous (3 intact, 14 fragments), but they revealed no intention of breaking. The other bones in this category, both the phalanx II and the hoof, are generally intact. They have no marks of artificial processing or canine gnawing. However, fossil canine feces excavated from the Zhokhov site contain crumbled phalanx, reindeer hairs, and small fragments of the horny cover of reindeer hooves.

Some general remarks on the morphology of the fossil reindeer from Zhokhov Island should be noted before discussing butchering practices. Data obtained on Late Pleistocene reindeer from the North and Middle Urals (Kuzmina 1971, 1976), the parameters of Final Pleistocene reindeer from the East Baikal Region (Kasparov 1986) and, of course, the well-known morphology of modern animals were compared with the collected items. Pleistocene Ural reindeer look slightly smaller in comparison with the Zhokhov fossils, while the fossil reindeer from the Baikal region are even much smaller. All the dimensions of fossil reindeer from Zhokhov Island are almost identical to the dimensions of animals inhabiting the tundra zone today (Table 9), though the Zhokhov fossils are more gracile. Thus the average length of metacarpals discovered on Zhokhov Island is 225.3 mm, while those for Pleistocene Ural and modern tundra reindeer are 190.6 and 203.2 mm respectively. Animals inhabiting the forest zone now look much larger: the average length of metacarpals is 229.3 mm; the length of metacarpal proximals and distals is 43.9 and 50.0 mm respectively (mid-value). The same dimensions for fossil Zhokhov reindeers are 35.2 and 42.0 mm respectively. The described morphological differences might have been determined by the natural environment (both the paleo and the modern) of the different regions, or by something such as the differences in depth of snow covers. At the same time, we acknowledge that the selection for discussion is too small, which often happens for fossils, and do not suggest the noted features to be regarded as facts.

The character of the fossil osteological remains from the Zhokhov site and the spatial distribution of bones make it possible to draw a significant conclusion. Careful examination of the bone remains—of both reindeer and bear—shows that the Zhokhov site was not a hunting camp where skinning and primary butchering of animals took place. It was evidently a living

**Table 9. Dimensions of some reindeer bones from different regions.**

| REGIONS | Zhokhov Island site* | | North Ural area*** | | Transbaikal area*** | | MODERN*** | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| DIMENSIONS | Early Holocene | | Late Pleistocene | | Late Pleistocene | | Tundra zone (R. t. tarandus L.) | | Forest zone (R. t. fannians L.) | |
| | N | M | N | M | N | M | N | M | N | M |
| MANDIBLES | | | | | | | | | | |
| Alveolar length of the molar row | 8 | 95.5 | 4 | 101.2 | – | – | 14 | 96.2 | – | – |
| HUMERUS | | | | | | | | | | |
| Distal breadth | 20 | 47.0 | 27 | 45.1 | 3 | 40.54 | 48.0 | 2 | 51.2 | |
| Length of the ventral angle | 5 | 44.5 | 2 | 42.9 | 3 | 50.2 | – | – | – | – |
| Distal height (epiphyses) | 4 | 44.5 | 3 | 50.2 | 2 | 42.2 | – | – | – | – |
| RADIUS | | | | | | | | | | |
| Proximal breadth (epiphyses) | 12 | 47.8 | 14 | 45.6 | 2 | 41.2 | 4 | 47.6 | 2 | 50.8 |
| Distal breadth (epiphyses) | 15 | 43.9 | 14 | 42.0 | 1 | 41.3 | 4 | 44.9 | 2 | 48.8 |
| METACARPALS | | | | | | | | | | |
| Total length | 5 | 225.3 | 14 | 190.6 | – | – | 4 | 203.2 | 2 | 229.3 |
| Proximal breadth (epiphyses) | 23 | 35.5 | 17 | 34.3 | – | – | 4 | 36.5 | 1 | 43.9 |
| Distal breadth (epiphyses) | 23 | 42.0 | 14 | 41.6 | 1 | 41.8 | 4 | 44.0 | 1 | 50.0 |
| TIBIA | | | | | | | | | | |
| Distal breadth | 14 | 41.6 | 30 | 40.2 | 2 | 38.7 | 4 | 41.5 | 2 | 45.5 |
| ASTRAGALUS | | | | | | | | | | |
| Total lateral length | 13 | 46.6 | 103 | 45.6 | 4 | 45.0 | 4 | 47.0 | 2 | 51.9 |
| Distal breadth (articular block) | 13 | 29.0 | 103 | 28.4 | 4 | 26.2 | 4 | 29.4 | 2 | 32.6 |
| METATARSALS | | | | | | | | | | |
| Proximal breadth | 4 | 32.5 | 12 | 30.8 | 1 | 24.3 | 3 | 31.5 | 2 | 35.4 |
| Distal breadth | 31 | 42.6 | 3 | 42.6 | 1 | 38.3 | 3 | 44.0 | 2 | 47.7 |

* after Pitul'ko and Kasparov (1996)
** after Kasparov (1986)
***after Kuzmina (1976)

site. To support this idea we refer to the data obtained by researchers at hunting camps of the Alaska Eskimos, who have a centuries-old history of caribou hunting. The hunting traditions determine the standard butchering procedures, and a specific spatial distribution of bones was associated with the kill sites and the living sites.

Thus Binford (1983) notes that the butchering of caribou occurs at a special temporary camp (kill site) and begins with the skinning; when it is done, the hunters put the hide away. They then butcher the skinned animal and remove the dismembered parts, liver, and fragmented bones to the border of the butcher area, creating in this way the circular feature. When the butchering is finished, the spinal column with skull, pelvic bones, and fragmented ribs are left at the center of the butchering area. Binford suggests that perhaps prehistoric hunters did the same. Accordingly, the circular distribution of bones and the abundance of intact vertebrae, pelvic bones, and other bones might be considered clear indications of kill sites. Describing their distinctive features, Binford notes another specific indication of kill sites—the abundance of fire places. The hunters spend a long time in the open air in the very cold Arctic spring and need warmth when skinning a large number of killed animals.

Taking into account Binford's observations, we examined the spatial distribution of the archaeozoological materials at the Zhokhov site. Though some specific concentrations were revealed, the spatial distribution for categories of skeletal remains in general is chaotic, as mentioned above, and clearly differs from the circular planigraphy of kill sites. Neither intact spinal columns nor abundant separate vertebrae (of either reindeer or bear) were found at the site. The latter are mainly atlases and axes, and generally very rare (Figure 60, 61). A large number of the excavated bones are broken. Thus reindeer metacarpals and metatarsals were doubtless split and broken to extract marrow. According to Binford (1981), such a method of fragmentation is customary only for the base sites of northern hunters; at the kill sites they are able to use more accessible food sources such as the tongue, liver, and blood.

At the same time, it is obvious that a large number of bones (both polar bear and reindeer) were concentrated at the central part of the excavated area (Figures 11, 13, 62) in Sections 12, 16, 22–26, 28. But this area is rich in artifacts and wooden pieces, and perhaps the spatial distribution of faunal remains discovered at the Zhokhov site repeats a common feature of spatial distribution. Other sections, excluding Section 49, have a more or less constant number of bones. The nature of this difference is unclear. This is probably the result of human activity, but at the same time it could be some kind of natural accumulation (solifluction or something similar).

The recurring character of damage on bones from the Zhokhov site makes it possible to advance some conclusions on butchering practices. Some marks could be connected with other processes (cooking, eating, canine gnawing), but certain traces of dismembering were discovered in the different categories of bones described above. The methods of butchering presumably might be reconstructed. The general succession of butchering used by modern native peoples for ungulates has been described by Binford (1981:91–92) in this way: (1) All groups ideally separate the head from the neck between the occipital condylus and the atlas vertebra. (2) All groups except the Navajo separate the neck from the remaining vertebrae. (3) All groups separate the front legs from the axial skeleton. Those that further cut the front legs into upper and lower segments generally do this between the carpals and the distal radio-cubitus. (4) All groups separate the rear legs from the vertebrae; however, there is considerable variability in the degree to which half the pelvis is left attached to the rear leg as opposed to the axial skeleton. In all the ethnographic cases recorded—where either axes, adzes, or large cleaver-type knives were used in butchering—the pelvis and/or sacrum were cut from the rear leg. Where small knives were used, the pelvis and/or sacrum were cut from the lumbar vertebrae or as a separate unit distinct from the rear leg. (5) All groups generally treat the spinal column with ribs and brisket distinct from the other major parts of the anatomy, but there is considerable variability in the way the thorax and spine are cut into small units. Most, but not all, cut the ribs and sternum off as independent units.

Perhaps the prehistoric natives of Zhokhov Island used the same strategy, but the information is not complete enough to draw such a conclusion. Nevertheless, some methods of butchering can certainly be specified.

Taking into account Binford's ethnological observations and the osteological collection where some categories of bones are missing (Figures 60, 61), it can be assumed that the hunters of Zhokhov Island, like the modern Eskimos, rarely cut the heads of reindeer from the spinal column and brought the heads to the living site even more rarely. Nevertheless, the method of removing the heads was standard and used in butchering both reindeer and polar bears: the heads were cut off near the atlases by chopping the axes, which are always very fragmented. But nothing can be said about the cutting of the neck.

Several steps are identified for cutting off the forelegs. (1) They were carefully cut from the body without breaking the shoulder joint. This probably took place at the kill site. The succession of other steps was not revealed, so we will consider them in anatomical order. (2) Dismemberment of the shoulder joint was executed by rough slashing of the proximal sections of the humeri, clearly marked by standard marks on the latter. (3) The elbow joints were dismembered carefully by dissecting the strong tricep tendon that attaches to the olecranons of the ulnae, and the latter were regularly chopped off together with the tendons. Taking into account that the epiphyses of the bones in the elbow joint (the ulnae and radii proximals and the distal humeri) are intact or lightly damaged, we can assume that the joints were carefully broken without striking, and then broken to extract marrow. (4) The cutting of the carpal joints was also careful inasmuch as both the proximal epiphyses of the metacarpals and the distals of the radii are usually intact. However, some epiphyses of metacarpals are broken. Obviously, the latter is not a sign of butchering technology; the damage appeared when the bones were split lengthwise for extracting marrow or for some other purposes.

Information on butchering the hind legs is very scanty. The hunters undoubtedly detached the femurs from the pelvis and then left the latter together with spinal column somewhere beyond the living site. This is indicated by the extremely small number of pelvic bones. The order of butchering the hind legs is uncertain since only a few fragments of reindeer femurs and tibiae were collected. Rich in marrow, these bones were evidently greatly fragmented. The same categories of bones are absent among bear skeletal remains. But perhaps their absence may be explained by the characteristics of spatial distribution.

The cutting of reindeer ankle joints can be described in more detail. First, the abundant components of the joints are less damaged. The only regular deficiency is the absence of the rear section of the heel bones. On the other hand, the intact ankle joint consisting of the tibia distal section, the talus, and the central tarsal bones was found. All bones are nearly intact. The above facts allow one to assume that the hunters cut off the intact ankle joints together with the metatarsal bones. To execute this procedure they had to break off the distal section of the shank bone and to dissect the Achilles tendon fastened to the head of the heel bone. A similar procedure was followed to break the elbow articulations.

The breaking of the shank bone and the cutting of the strong Achilles tendon might have been done when the ankle joint was straightened. In this position, the head of the heel bone and the distal extremity of the shank could easily be detached in one blow. The procedure results in the occurrence of very short distal fragments of the shank bones. Thus the latter are most abundant, and the described procedure was evidently in practice at the Zhokhov site. Keeping in mind the longer distal fragments, however, we need to note that sometimes procedures might be executed separately.

As a valuable food source and raw material, the metatarsals they were carefully separated from the ankle joints without striking and slashing. Their proximal epiphyses are almost all intact.

Describing the strategy and procedures of the butchering technology that is practiced by the Eskimos, Binford wrote that they dismember the legs of animals by inserting the knives into the bent joints. However, he notes that this is doubtful when using stone tools, because the applied pressure is too large and consequently the method is suitable only for the iron knives. Keeping the above in mind, Binford assumes that the general strategy of butchering with stone tools which took place in prehistoric times was based on superficial cutting of tendons. Then further separation of the bones might be accomplished. The results of the examination of the archaeozoological collection from the Zhokhov site tend to support this conclusion.

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Though materials from the Zhokhov site show that human occupation of the territory occurred near the Early Holocene climatic optimum, key questions about initial migrations into the East Siberian high Arctic have not been answered definitively. On the one hand, the area was accessible and the natural environment was more or less favorable during the Sartan Glacial. Yet nothing is known about Late Pleistocene human migrations to these territories other than the location of broken bones of large mammals discovered by Mochanov at one of the southern islands of the New Siberian archipelago in the 1970s (Mochanov, personal communication). The finds from Zhokhov Island force us to remember the information obtained as far back as 200 years ago by the pioneers of Russian explorations on the New Siberian archipelago—Matvey Gedenshtrom and Yakov Sannikov, who found some interesting objects on Novaya Sibir' (New Siberia) and the Kotelny Islands from 1809 to 1811. Gedenshtrom (1822:300, 301), who was the leader of the expedition, wrote in his notes that Sannikov found "an axe made of ivory resembling tools used by the Chukchi" on the west part of Kotelny Island. In addition, Gedenshtrom was informed about some camping places found both on the Kotelny and Novaya Sibir' Islands and ascribed by Sannikov to the Yukagir. But the latter (and the Yakut as well) never occupied these islands. Perhaps Sannikov and Gedenshtrom saw the locations of ancient sites with abundant split wood, broken bones, and other artifacts lifted to the surface by permafrost, as was the case for the Zhokhov site. I believe other traces of early human migrations to the region of the New Siberian archipelago will be found during future explorations.

# CHAPTER IV

## Terminal Pleistocene–Early Holocene Relics of Northeast Asia and the Zhokhov Assemblage

Because of the unique location and excellent preservation of different organics, which are usually absent in contemporaneous sites, the Zhokhov assemblage considered in the previous chapter is undoubtedly one of the most illuminating archaeological sites of the Stone Age in Northern Asia, and it could be said that the Zhokhov materials are both a simple subject for discussion and at the same time a difficult one. In general, it lacks exact similarities with contemporaneous assemblages (with relics of Northern Asia that are approximately contemporaneous with Zhokhov). However, a lot of artifacts make it possible to find broad analogies illustrating more general trends of Late Pleistocene–Early Holocene cultural development in the region, rather than a few similar features of the Zhokhov assemblage with neighboring sites and cultures. This is important because the information contained in the Zhokhov finds is a real and important contribution to general notions of human history.

Through the collection and carbon dating of the site, one can easily point out the general background for the Zhokhov Island site. These are Mesolithic relics of Northeast Asia comprising the Sumnagin cultural phenomenon or the Sumnagin culture of the Holocene Paleolithic in the view of Yuri A. Mochanov, and supported by other Yakutian archaeologists. At the same time, the Sumnagin materials can be interpreted as Mesolithic from the theoretical point of view (see above).

The previous (Late Pleistocene) stage of human occupation of the Northeast Asian region is considered to be connected with the spread and development of the Paleolithic Dyuktai culture. Although these questions were partially discussed above with respect to the correlation between environmental and climatic changes and human migrations in the Arctic, I will now revisit with regard to the archaeology itself.

Knowledge of the history of the early occupation of the East Siberian Arctic (as well as notions on other stages of Stone Age occupation in Northeast Asia identified by Yu. A. Mochanov and S.A. Fedoseyeva) differs distinctly from that of areas southward from the Arctic Circle, where the eponymous sites are located. Numerous and well-studied, the latter provided a basis for the outline of cultural development later applied to the archaeological materials of the continental regions of the East Siberian Arctic. It must be stressed that ideas on both the chronology and the cultural interpretation of the northern sites are based primarily on southern materials, owing to scarce information from the northern ones. Once again, a number of the sites representing different stages of the Polar Stone Age are extremely unequal. If there are a few dozen Neolithic sites in the continental regions of the East Siberian Arctic, the early sites are quite rare. Thus few sites are considered to be of the Dyuktai or Sumnagin culture, whose connection with the Late Paleolithic (or the Mesolithic) culture is relative at best.

First, let us consider the Late Paleolithic sites. Although the Berelekh findings are the best known among them (Vereschagin and Mochanov 1972; Mochanov 1977), there are others pointed out by various authors as the Late Paleolithic: the Bochanut (Mochanov 1977:93, Map, Fig. 2) and Chokurdakh sites (Mochanov 1972:251; 1977: Fig. 2); Kigilyakh (Mochanov and Fedoseyeva 1980: Map, Fig. 2); Maiorych (Mochanov 1977:90–92), Olenek I (Mochanov, Fedoseyeva, Konstantinov et al. 1991:57–58); Kuranakh I (Scherbakova 1980:64)—in Yakutia. Farther eastward are Ryveyem on the Aion Island (Dikov 1960:98); Kymynyikei Mount in the Vankarem Depression, Chukotka (Laukhin, Drozdov et al. 1989:136–140), and six sites found by Dikov (1993a, 1993b) on the Chukchi Peninsula—Ul'khum, Chaatam'ye I, Kymynanovyvaam VII, VIII, and XIV, Ioniveem VII, and Igel'khveem XVI, which are supposed by N.N. Dikov to comprise the Beringian Late Paleolithic Tradition together with previously known sites such as Ines'kvaam I (Dikov and Kolyasnikov 1979:20–28) and Kurupka I (Dikov and Kazinskaya 1980:24–29; Dikov 1993a). This new cultural phenomenon, i.e., the Beringian tradition, is presumed to date to 13,000–10,000 BP (Dikov 1993b:46).

The Kigilyakh and Bochanut sites mentioned above are represented by accumulations of fragmented bone remains of animals of the Late Pleistocene faunal assemblage, and they can be discussed as a good argument for prognosis rather than direct evidence of Pleistocene human occupation of the East Siberian Arctic. However, justice demands noting that some bone fragments from Bochanut, examined by S.A. Semenov, have in his opinion use-wear traces recognized as discontinuous polishing, scratches, and struck surfaces (Mochanov 1977:93). Unfortunately, these observations are not helpful in clearing up the most interesting question—the age of the finds. In that connection Mochanov notes the skeptical opinions advanced in the discussion of the Old Crow bone industry.

The Kuranakh I site (Yana River), where "a mid-size flake of patina-encrusted slate and three slate chips," together with "a scraper, a piece of a scraper, and a small scraper," found in talus (Scherbakova 1980:64), as well as the Chokurdakh site (lower reaches of the Indigirka River) where a very few flakes were gathered, are considered Paleolithic sites for unknown reasons—even if the location of the Chokurdakh site, discovered on a high terrace, is taken into account. The Olenek I site, discovered in the area of the same name, appears to be more informative. But unfortunately the cultural layer of the site was disturbed by recent human activity, and the artifacts collected by Konstantinov are undoubtedly a composite of several chronological generations of archaeological material. That is, distinct Neolithic types can be easily recognized, and some early artifacts (most probably Mesolithic) are mixed with them; it is impossible to identify them precisely because of the great similarity between Early Neolithic (and even later) and Mesolithic materials observed in Northeast Siberia. However, it is supposed that a few artifacts of the Late Paleolithic Dyuktai culture are represented in the collection (Mochanov et al. 1991:57). I do not share this view, considering the artifacts published by the researchers (Mochanov et al. 1991:Table 105–109). There is a rather large selection, most likely including the best and the most characteristic items. And only one artifact would have been recognized by Konstantinov as a wedge-shaped core. Judging by the picture (Mochanov et al. 1991:Table

106:2), I see this as a fragment of a bifacially flaked tool generally resembling a wedge-shaped core but lacking a striking platform and blade negatives. Another site with a few surface finds is on the lower reaches of the Kolyma River at 63°N (Mochanov 1977)—the Maiorych site, which looks good in comparison with the Paleolithic admixture of the Olenek-I assemblage. A perfect wedge-shaped core, three flakes, and two combination tools were found there (according to Mochanov, they can be identified as a knife-scraper and knife-chisel). Wedge-shaped cores similar to the Maiorych core are known from the Ikhine I and Verkhne-Troitskaya sites, and from Dyuktai Cave where they are dated, according to Mochanov, to 30,000–25,000 BP, 23,000/22,000–18,000 BP, and 13,000–12,000 BP respectively. The period of most extensive distribution of cores of that type is thought by Mochanov to be contemporaneous with the Verkhne-Troitskaya site (Mochanov 1977:92). Thus the question remains open, especially with regard to the Holocene wedge-shaped cores of the Siberdik culture, which are on the upper reaches of the Kolyma River (Dikov 1979:90–93, Fig. 31).

An amusing story about the "Ryveem microblade": a find was made in an exposure in a precipice of the Ryveem River on the Aion Island (very close to the northern Chukotka coast near Chaun Bay) in 1959 (Dikov 1960:98), and it was transformed into evidence of the populating of the Arctic as far back as in Paleolithic times (Dikov 1973). This was carefully traced back by Mochanov (1977:95–97), who concluded that the artifact mentioned, though a microblade, really proves nothing.

Finds discovered in a core sample taken from a hole drilled near Mount Kymynyikei were discussed in Chapter II. Although their chronology remains disputable (I could advance at least three scenarios explaining the age and position in a way other than that by Laukhin and coauthors), one should still point out that this is the only site in Chukotka that makes it possible to discuss the Paleolithic occupation of the territory. Nevertheless, the problem of antiquity there remains open.

As for the Paleolithic sites discovered by Dikov in Chukotka, it is difficult to consider the finds (Pitul'ko 1992a:79–82) since the artifacts come mainly from surface collecting—except the Ul'khum site, where the findings were excavated from a surface cultural layer (Dikov 1993a:40, 41). In addition, the assemblages generally lack diagnostic artifacts. The published articles (Dikov and Kazinskaya 1980:Fig. 1; Dikov 1985:3–11, Figs. 1–7; Dikov 1990:Figs. 4, 5, 8, 9; Dikov 1993a:Tables 1, 6, 107, 108; Dikov 1993b:Figs. 17–20) suggest that there is a rather large quantity of microprismatic cores of the tortsovy type (naturally flat, or flattened, with narrow flaking surface), which are mainly fragmented. A considerable number of the cores are made on massive flakes, flat stones, or slabs of raw material; it is difficult to understand why some of the latter were identified as wedge-shaped cores, especially since dating of the assemblages is based precisely on identification. Accordingly, these are misdated, yet interesting, carbon dated complexes of early Holocene sites discovered by Dikov while surveying the eastern Chukotka area (Dikov 1993a). With regard to primitive stemmed points that for the finder resembled those from Cultural Layer VII of the Ushki site, I do not want to discuss ideas connected with the situation in which the artifacts were found.

It is not out of the question that the dating of the sites will be revised in the future. For instance, the Ioni X site, considered previously as a Paleolithic site (Dikov 1990:17), was never mentioned later among these new-found sites.

Summing up, one might note that only three sites—Berelekh, Maiorych, and Kymynyikei—represent real evidence of an early stage of peopling of the continental Arctic areas in the Late Pleistocene. The upper chronological boundary of this stage is marked more or less definitely (13,000–12,000 BP) by the Berelekh carbon dating, which shows Dyuktai people to be the pioneers. Strictly speaking, Late Pleistocene sites are not particularly numerous in Eastern Siberia, even southward from the Arctic Circle, except for the Lena River basin (Mochanov 1977; Mochanov et al. 1983, 1991, etc.). However, the Kheta site on the upper reaches of the Kolyma River (Slobodin 1992), and probably the Bolshoy El'gakhchan site on the Omolon River in Western Chukotka (Kiryak 1993), could be mentioned.

The greatest cultural phenomenon in the history of Northeast Asia near the Pleistocene-Holocene boundary is the Sumnagin culture. Sites of this culture defined by Mochanov are known from west to east (from the Taimyr to Chukotka), and from the coast of the Arctic Ocean southward. In Mochanov's opinion, which is neither supported nor disproved by anyone, sites belonging to this superculture (or affected at least by the latter) occurred in Alaska during the terminal period of its development (Mochanov 1977:252). This huge, powerful archaeological culture, which affected cultural evolution over an extremely extensive territory, is the great mystery of Early Holocene archaeology of Northeast Asia. Although its sites are well known and studied (mainly in southern areas), nobody can advance a realistic theory explaining the origin of the phenomenon that occurred about 11,000 BP and covered the above-mentioned territory in only 3,000 years. The point is its complete dissimilarity to the Dyuktai culture, which covers approximately the same areas. There is no succession, and they are different in every significant feature of both knapping technology and secondary tool processing. The former is of distinct bifacial style, while this was almost totally absent in the latter; the wedge-shaped cores predominating in the former have never been found in Sumnagin contexts. Mochanov tends to explain the sharp change in cultural tradition near the Holocene boundary as the result of forceful migration, supposedly from the Yenisei region, where similarity can be found between the Sumnagin and the Kokorevo culture of the Late Paleolithic Malta-Afontovo tradition (Mochanov 1977:255). I do not share this view but still do not see the possibility of advancing an alternative.

The major part of the Mesolithic Sumnagin sites is known outside of the Arctic region of Northeastern Siberia—in the Aldan, Vilyui, and Olekma valleys (the Lena River system). In the Arctic they are thought to be in the Taimyr—the Pyasina I, III, and IV sites (Khlobystin 1973a), the Tagenar VI site (Khlobystin 1973c)—and probably some others, such as the Lantoshka II and Malaya Korennaya III sites (Khlobystin 1973a:94). Numerous assemblages have been discovered in North Yakutia—Staraya II, Delingde II, III, and IV, Chuostakh-Yuryuge, Yakutsky Tyubelyakh, Ulakhkhan-Kyuel'-Seene, Baian, Berelekh-Aian, Ochugui-Manyngda, Khotugui-Neiuo, km 255 I and II, Khorbusuonka I, and the Bilir site (Mochanov, Fedoseyeva, Konstantinov et al. 1991). Sumnagin sites are fewer farther eastward, perhaps due to scantier research carried out in this area. Thus there are the Panteleikha I–VIII sites and the Pirs site on the lower reaches of the Kolyma River (Mochanov 1977:203, 204); in addition, other sites probably contain Mesolithic materials. The Tytyl Lake I–III sites were discovered in Western Chukotka, at the source of the Maly Anyui River (Kiryak 1991). And Dikov found some sites while surveying the easternmost territories of the Chukchi Peninsula—Puturak, Itkhat IB, Ul'khum ("lower part" of the site), and Chel'kun IV. It is also possible that Early Holocene complexes were recognized by Dikov as partly Paleolithic (Dikov 1993a).

It can be easily seen that the Mesolithic sites are distinctly more numerous than the Paleolithic ones. Of course, this is evidence of the more concentrated occupation of the Arctic in the Early Holocene, but these materials are not of much value. They give a good impression only if listed. Thus most of the North Yakutian assemblages thought to be Mesolithic are represented by surface finds collected here and there, and both sites with few finds and those where numerous artifacts were collected are known. The latter are often of a mixed character and contain Neolithic ceramics of different types and implements belonging to late periods of the Stone Age. The Yakutsky Tyubelyakh, Ulakhkhan-Kyuel'-Seene, Khotugui-Neiuo, and Khorbusuonka I sites, thought to contain some Mesolithic artifacts, are of this type; typology-based interpretations of some of the materials as Sumnagin finds have never been proven. It is almost impossible to recognize actual Sumnagin artifacts comprising assemblages along with Neolithic tools inasmuch as many of the implements from pure Sumnagin complexes can be found in Neolithic sites. In general, researchers restrict themselves to statements of possibility regarding the presence of Mesolithic Sumnagin artifacts as part of a group among these sites. At the same time, a lot of sites are assumed to be from the Early Holocene (i.e., which are thought to belong to the Sumnagin culture), where few artifacts (blades and/or flakes and no diagnostic tools) were found. These are often surface finds: Delingde I and IV, Chuostakh-Yuryuge, Baian, Berelekh-Aian, km 255 I and II, and Bilir site (Mochanov et al. 1991). Other assemblages, such as Staraya II, Delingde III, and Ochugui-Manyngda, contain some atypical artifacts that are diagnostically useless. This quick view on the Northern Yakutian sites—thought to be from the Early Holocene—shows that they are interpreted unsystematically; the general diagnostic principles used by the authors of the Handbook of Yakut Archaeology (Mochanov et al. 1983, 1991) in considering the assemblages still remain unclear, and I fail to understand why at least half of the above-mentioned sites are identified as Early Holocene. For example, I was unable to find a difference between the Delingde I and II sites. Eighteen flakes and 9 microblades were collected on the former from an eroded cultural layer (?) that was dated to the Early Neolithic—no more than 6000 BP (Mochanov et al. 1991:52). But the latter, which contains only a ridged flake and one preform (for what?), is supposed to be from the Early Holocene. It is interesting that the former were collected in talus of the 25–30-meter-high Anabar River terrace, while the latter were discovered in accumulations of an 11–13-meter-high terrace. The reverse order looks more logical, if one assumes the height of the terraces to be a basis for local chronology. Although some relative observations could be obtained in that way, the problem was never studied from that angle.

A large area of the Northeastern Yakutia—the Yana River basin—was surveyed in the 1980s. More than 70 archaeological sites of different chronology and belonging to different cultures were found there (Scherbakova 1980; Mikhalev and Yeliseyev 1992). The majority of the artifacts come from mixed assemblages. This is why V.I. Mikhalev and E.I. Yeliseyev do not want to discuss the cultural chronology of the finds, noting that the assemblages discovered are in general from the Holocene.

The sites known on the lower reaches of the Kolyma River (the Panteleikha I–VIII and Pirs sites) contain mixed assemblages of Neolithic, Bronze, and even Iron Age artifacts, as do a major part of the North Yakutian complexes (Mochanov 1977:204). The early component (Sumnagin) is recognized by the presence of end scrapers on massive blades or lamellar flakes with a ventrally retouched oval-convex working edge (Mochanov 1977:Table 75:11, 12, 15, 17, 18), or carinate scrapers whose working edges are sometimes shaped in a peculiar style. Mochanov calls the latter the ear-like prominences of the working edge (Mochanov 1977:Table 75:14, 15), which is supposed to be characteristic of Early Holocene Sumnagin scrapers. It is noteworthy that in commenting on the Upper Kolyma finds, N.N. Dikov (one of Yu. A. Mochanov's critics) has pointed out the inconsistency in Mochanov's consideration of this category (Dikov 1979:93). Namely, Mochanov is not inclined to assume a Final Paleolithic interpretation for the carinate scraper from Shilo Brook, Upper Kolyma area (Dikov 1979: Fig. 34); at the same time he supposes the carinate scrapers from the Panteleikha sites (absolutely the same, in Dikov's view, or at least very close to each other) to be a chronological feature of the Early Holocene "Paleolithic" cultural component of the Panteleikha assemblages. Dikov's opinion was later supported by Kashin (1983), but a discussion concerning the theoretical possibility of dating a part of the Panteleikha cultural remains to the Early Holocene is less important since the most significant questions of the Early Holocene archaeology of Northeast Asia have already been answered without these materials. Thus it is revealed that both the Pleistocene and the Early Holocene occupations markedly exceed the geographic position of the site locations under consideration; the Sumnagin cultural phenomenon occupied the territory covering the locations, and the chronology is well grounded without the support of data from the Panteleikha sites.

Reviewing the Mesolithic sites of the Taimyr Peninsula, one should note that the artifacts excavated from the Tagenar VI site (Khlobystin 1973c:11–16) appear to be the only subsurface context of the Sumnagin culture (or more properly, the terminal Sumnagin context) known in the entire Siberian Arctic, and the only carbon-dated one (6020 ± 100, LE-884). The collection is rather scanty, yet both Khlobystin and Mochanov definitely identified it as Sumnagin material (Khlobystin 1973c:15; Mochanov 1977:212). The assemblage from the Pyasina I site, although composed partly of surface finds, has definite Sumnagin features too (Khlobystin 1973a:89, 90). Conclusions on the surface contexts from the Pyasina III and IV, Lantoshka II, and Malaya Korennaya III sites were cautious. The same is true of other sites such as Pyasina V, IX, and XV, Malaya Korennaya II, and Kapkannaya II, which were later considered as from probable Mesolithic contexts (Khlobystin 1973c; 1982). However, the researcher noted that at least some of the materials could be discussed as Early Neolithic because of topography or other reasons. It is interesting that L.P. Khlobystin identifies as definite Mesolithic contexts containing simple points made on prismatic blades that are supposed to be arrowheads (Khlobystin 1982:7). But no indisputable projectile points were ever discovered in a subsurface context, though Mochanov assumed that at least a part of the undated lamellar arrow points found here and there in Northeast Asia could belong to the Sumnagin culture (Mochanov 1977:246). The implements mentioned are represented by both willow-leaf and tanged points made on prismatic blades with discontinuous marginal retouch. The latter is known only in rare cases, and the tips and basal parts of the points are bifacially trimmed (Mochanov 1977:Table 86). Considering the Yubileinaya assemblage, Kashin has noted that exactly the same points are known from Neolithic contexts, including Yakutian stratified sites (Kashin 1983:100, 101).

The Mesolithic of Western Chukotka is known from surface contexts at the Tytyl Lake sites, Loci I, II, and III (Kiryak 1980:39–52; 1993:23–31). The numerous stone artifacts collected at the sites are represented by prismatic cores (primarily with a circular flaking system), microblades, end scrapers, burins, and miscellaneous waste material; unifacial secondary retouch and a burin spalling technique are recognized as features of the assemblages. The artifacts are scantily published (Kiryak 1993:23, 26). At the same time the researcher has found space for a description and consideration of both the dwelling and the hearth structures, which had never been published previously. It remains unclear but would be interesting to know whether any of the artifacts were connected with the structures, and by what means the artificial origin of the latter could be proven (such as charcoal, thermal coloration or, on the contrary, the specific color of burnt stones). It is worth noting in this connection that the sites where so-called structures were discovered are located in the permafrost region where structured soils, occurring everywhere, are well known—even at the site location. As seen in the photo published by Kiryak (1993:Fig. 7), the Tytyl area is covered by typical tundra landscapes with circular structured soils. Therefore it is possible to assume that the circular accumulations of boulders and rock debris (Kiryak 1993:10–14), especially those that are identified as hearth structures, are most likely natural compositions occurring because of cryogenic sorting of fragmentary material. As a peculiar feature of the Arctic landscapes, the latter is well described in classic studies on cryolithology (e.g., Washburn 1958:106–119, Photos 2, 3, 6, 9, 10; Hopkins et al. 1958), and the artificial character of the structures needs to be precisely proven. Despite the brief description of the stone inventory from the Tytyl sites, its morphology is declared to be similar to the Mesolithic Puturak industry discovered by Dikov in easternmost Chukotka (Dikov 1993a), and to the origin of the Mesolithic of Chukotka region in general. In laying the groundwork for the latter, Kiryak notes that the difference between Sumnagin and Chukotka materials can be proven by a "series of end scrapers made on massive blades" and other implements found both at the Puturak and the Tytyl sites, inasmuch as the Sumnagin culture is characterized by numerous prismatic blades, bladelets, and microblades, and diverse tools made on them (Kiryak 1993:26). Still, prismatic blades and microblades are represented in both Tytyl and Puturak assemblages (corroborated in publications), which, in truth, are not numerous for unknown reasons. Though there are poor grounds for being diagnostic, the Tytyl contexts have no distinct differences from the standard Sumnagin collections, which include a perfect prismatic knapping technology, and microprismatic as well, and a characteristic series of end scrapers. Both Dikov (1979:132) and Kiryak (1980:51) have previously written about the indisputable analogies between Tytyl and Sumnagin finds, and the occurrence of the latter in the zone separating the Yakutian and Chukotkan Sumnagin sites identified by Dikov (1993b:52) in Chukotka cannot be unexpected. In my view, there is only the theoretical possibility of discussing the difference between the Sumnagin and Chukotkan Mesolithic, taking into consideration the frequency of artifacts with retouched dorsal surfaces in the Sumnagin and those in the Chukotkan Mesolithic sites respectively. Artifacts of this morphology are relatively frequent in Tytyl and Puturak sites, but I do not think that is the way to make accurate cultural definitions. There is a lack of information concerning numerous Sumnagin collections that have not been published completely; on the other hand, the morphology could be a feature of local cultural development. Most likely, technological flakes broken off from flaked core-preforms were utilized. One cannot help but note one end scraper has a peculiar morphology of the ventral surface: the latter is flattened by fine oblique parallel retouch (Kiryak 1993: Table 29:3), which is interesting because this technology is generally known in the Arctic from Late Neolithic sites where triangular massive scrapers with trimmed ventral surfaces are characteristic. Perhaps this is an indication of a late component bringing together Mesolithic finds from Tytyl Lake, which is typical for surface contexts found anywhere. And it is generally accepted that assemblages of this kind usually have an indisputable but unknown origin.

It is necessary to say a few words about the new-found Mesolithic sites of easternmost Chukotka such as Puturak, Chel'kun IV, Ul'khum (the lower part), and Itkhat I-B (Dikov 1993a). At least some of them represent not only surface contexts but excavated finds as well. One of the sites—Chel'kun IV—is carbon dated to 8150 ± 458 BP (MAG-719). The assemblages give the impression of homogeneous material even though they are composed of both surface and excavated finds. The characteristic feature of the latter is a "primitive" habit occurring because of the specific raw material of poor quality used for manufacturing the artifacts, of which a major part comes from various flinty rocks such as slate, tufa, and calcareous argillite. Assemblages are of poor and unstable typology and contain relatively large artifacts, although microprismatic technology is also well presented. Considering the collections, Dikov notes that the Chel'kun IV site (as well as the Achchen and Ananiveem sites) "marks the penetration of Mesolithic technology of regular Sumnagin type" into the easternmost territories of Chukotka (Dikov 1993b:52), while the "primitive unifacial technologies" of the Puturak, Itkhat I-B, and Ul'khum sites resemble to the researcher "finds from the the Galagher Flint Station, Trail Creek, and Anangula sites, which is a little younger." Dikov concludes that these sites are evidence of "the most important cultural component that participated in the formation of the ancient Beringian maritime culture, including finally the proto-Aleutian Anangula site," which he believes spread from Chukotka to Alaska around the Holocene boundary (Dikov 1993b:48).

Thus the continental part of the Siberian Arctic was undoubtedly occupied by the Sumnagin culture during some millennia. But it should be noted that the Sumnagin is not the only cultural phenomenon that existed in Northeast Asia during the Early Holocene. Very few sites with wedge-shaped cores, bifacial projectile points, and choppers—Kongo and Siberdik belonging to the Siberdik culture of the "relic Paleolithic," as defined by Dikov in the 1970s—appear to be original on the Early Holocene "Sumnagin background" (Dikov 1979). Another cultural complex—the Maltan site, discovered also in the Upper Kolyma area—differs markedly from both Sumnagin and Siberdik sites (Dikov 1979), but it is unclear whether there are cultural distinctions or other specifics.

The most recent research carried out in Northeast Asia give results picturing the Terminal Pleistocene–Early Holocene cultural evolution in the region as much more complex. If it were possible previously to consider only two probable tendencies—the Sumnagin line, the starting point of which is most likely connected with a powerful influence or a migration that affected the sharp replacement of the cultural tradition in Northeast Asia, according to Mochanov; and an autochtonous one presented by the relic Paleolithic Siberdik complex (according to Dikov)—the current situation becomes more complicated after the finds in the Northern Okhotsk Sea area, known from I.E. Vorobei (1992). The collection from the Druchak-B site, discovered by Vorobei, contains a diagnostic trio that can be described as follows: "wedge-shaped micro cores, Verkholensk-type (transverse) burins, and biface points." The trio is associated with large, massive blades flaked from monofrontal cores with one or two platforms, which are said to be uncharacteristic for Northeast Asia but still make it possible to discuss questions of a third direction for regional cultural evolution, connected with the pre-ceramic complexes of the Far East (Vorobei 1992).

However, the Sumnagin relics are the proper cultural background for the Zhokhov assemblage in the Arctic areas of Northeast Asia. As noted above, identification of the materials could be relative to some extent, and even if the presence of the Sumnagin component is indisputable, it is impossible to define exactly the Sumnagin implements in surface contexts since the Early Neolithic Syalakh culture covering the same area presents numerous artifacts in common with the Sumnagin. Normally, the artifacts can be considered Sumnagin when, on the one hand, there are no wedge-shaped cores or bifacial tools in any context, or on the other, the context is lacking bifacial implements and ceramics (but contains a microblade industry). If these two conditions are satisfied, the context could be interpreted as Sumnagin, as has been the case with numerous sites (Pitul'ko 1991). Except for a few of the latter, Sumnagin materials discovered in the Arctic come from surface contexts that are obviously useless for defining the cultural chronology of the Arctic area of the Sumnagin culture, its local distinctions, etc. However, there are a lot of stratified sites southward (including the eponymous one) whose materials were first defined as Sumnagin (Mochanov 1969; Mochanov and Fedoseyeva 1976). In general, they share the same characteristics, which permit extrapolating the conclusions to the Arctic area occupied by the culture. Published data reveal that they are extremely uniform assemblages, containing microprismatic cylindrical cores with one or two opposite striking platforms, abundant microblades, flakes, chips, and other artifacts; the implements are made primarily on blades. The total content of the latter reaches 90% in some assemblages, but most tools made on blades (simple lateral burins, angle burins on broken blades, borers, insets) are useless for diagnosis. Other artifacts made on blades, such as knives (blades with continuous retouch on the edges), points, end scrapers, and notched tools, are not numerous. A few of the Sumnagin implements are made on waste flakes. According to Mochanov, there are two characteristic features of this culture—the absence of any bifaces and projectile points and the presence of so-called worked pebbles constituting no more than 5% of the total Sumnagin collection. To put it another way, this is a series of microblade industries defined as a culture due to a common chronology and general similarity of the materials. No subdivisions of the culture were defined; perhaps precise statistics of each context will make it possible later.

Concerning Zhokhov, it can be said that the opportunities for comparing its artifacts with those of Sumnagin are extremely restricted by the nature of the materials. If all of the bone, antler, and wooden artifacts were removed from the Zhokhov collection, the rest of the collection would be another normal microblade industry containing some blades and bladelets, waste flakes of different size (including a big one that could be recognized as a primitive side-scraper), microprismatic cores, pre-cores, seven insets, and a single fragment of a notched blade. And it would be associated with abraders, ground tools, and flakes with ground dorsal surfaces broken off during reshaping or resharpening of the latter. This is a typical picture, well known from surface or even subsoil contexts in Northeast Asia. If the homogeny of the assemblage is not proven, the conclusion about its mixed character might be objective. Or perhaps one should date them to a later period because of the ground tools, etc. But as at the Zhokhov site we have observations on the perfect stratigraphic position of the artifacts, the assemblage is carbon dated by a series of isotope dates obtained in different laboratories. Concerning the age, the Zhokhov Island site, being dated to 8000 BP, is an early one for the high Arctic (see Chapter III). However, ground tools (mainly adzes) occur in the region much later, around 6000 BP (Mochanov 1977:222), and are completely unknown in sites contemporaneous with the Zhokhov site. Among the Sumnagin ground implements found in Horizon IV-b of the Ust-Timpton site (Mochanov 1977:Fig. 54:25), one adze appears completely analogous to that from Zhokhov (Figure 27:2). But while the latter is ground, the Ust-Timpton one is bifacially flaked. The horizon from which the adze came is dated to 9000 ± 100 BP, LE-832 (Mochanov 1977:152). It is interesting that a flaked adze with ground working edge was found in Horizon IV-a of this site (Mochanov 1977:159, Fig. 52:43), dated to 7000 ± 90 BP (LE-895). As follows from a description of the profiles, the cultural remains discovered in both horizons are contained in the second bedded layer of fluviatile (floodplain) facies of the bank ridge, where from 10 to 16 thin black-colored interbeds saturated with humus were counted. This bedded stratum was described as Horizon IV, composed of substratum "a" (the upper half) and "b"; the former has a general thickness of 20 to 30 cm including 5 to 7 humus interbeds; the latter horizon, of the same thickness, contains 10 or 11 interbeds (Mochanov 1977:152, 155, 159). This is the stratum of common lithology that was defined as a succession of layers "a" and "b" due to a 2 to 6 cm thick sand interlayer overlying Horizon IV-b in one part of the excavation (Mochanov 1977:152). At the same time the thickness, varying from 2 to 6 cm, is supposed to be a normal feature of the stratum composed of alternating sand and sandy soil beds; this is apparent from the profile description (Mochanov 1977:152). To put it another way, the defined horizons are the relative, artificial subdivisions applied to the stratigraphic succession. There are the two above-mentioned carbon dates that differ from each other by 2,000 years. To my mind, neither of these dates is objective enough and cannot be considered attesting to continuous accumulation of the stratum IV (a+b). The latter was most likely deposited during a relatively short interval around 8000 BP (the average of the two dates), that is, the cultural remains contained in the stratum are approximately contemporaneous with the Zhokhov site. In this connection I point once more to the series of carbon dates known from Zhokhov (Table 1), where the dates 7800–8000 BP are the most frequent but some deviations reach not just 2000 but even 4000 years.

Other artifacts from the Zhokhov site (flakes, blades, bladelets, insets, and the notched blade) are totally useless as diagnostics. For the stone artifacts, there is only one way to compare the core morphologies of the Zhokhov artifacts with those of neighboring territories.

Comparison becomes complicated due to the rather brief description of the Sumnagin cores published by Mochanov and others (Mochanov 1977; Mochanov et al. 1983, 1991). Surprisingly, a description of this very specific material was not included in the general description of the cultural evolution in Northeast Asia advanced by Mochanov (1977:241–246). Nevertheless, numerous publications make it possible to recognize the main features of Sumnagin core morphology. But first it must be noted that cores of Zhokhov morphology have never been found in the northern area of the Sumnagin culture, either in a pure or a mixed surface, or in a subsoil context.

Published data indicate that there are prismatic cores with one (pencil-shaped, cone-shaped, and flattened cone-shaped) or two opposite striking platforms (cylindrical) found at Sumnagin sites, tortsovy-type cores (with one narrow flaking surface on the edge), and wedge-shaped cores (Mochanov 1977:Table 48:4). The latter are extremely rare, discovered only at the Ust-Timpton site, where they are occasionally thought to be. According to the publications, the cores from Sumnagin sites are primarily exhausted ones or near the terminal stage of utilization, and it is difficult to advance an idea on their previous morphology (Mochanov 1977:Tables 32: 20; 35:17–21, 23, 24, 29; 40:20, etc.). However, some significant features of core morphology are noted in the descriptions that resemble to some extent that of the Zhokhov artifacts. Thus Mochanov notes that flaked pre-cores look like rectangular (parallelepiped shaped) items or partly flaked stone slabs or other more or less rectangular broken raw material (Mochanov 1977:110, 167). Opposite striking platforms (oval or rounded) of cylindrical cores are almost parallel to each other, being perpendicular to the long axis of the artifacts (Mochanov 1977:115, 121, 167). The upper platforms, which were used more intensively, are carefully trimmed in comparison with the lower platforms. As noted, microblades were knapped mainly from the upper platforms (Mochanov 1977:121, 167). But the knapping technology known from pure Sumnagin sites seems to differ in general from that of the Zhokhov, and Mochanov shares this opinion after examining the collection himself.

It is noteworthy that nothing analogous to Zhokhov stone implements has been found in the few years of excavations in the entire Asian Arctic. But surprisingly, similar artifacts were recently discovered by Dikov in Eastern Chukotka at sites such as Puturak, Itkhat I-A and I-B, Chelkun IV, and Ulkhum (lower) site. Cores of just such morphology were collected there, which was described for the Zhokhov artifacts. Some of them seem to be exact replicas of the latter, being identical in detail to Zhokhov cores (Dikov 1993a:Tables 46, 52, 60, 107; 1993b:Table 24). The age of the finds corresponds well to Zhokhov too. Thus a charcoal sample from Chelkun IV site was dated to 8150 ± 150 BP, MAG-719 (Dikov 1993a:149). There are other sites where the Zhokhov-type microblade cores were found. Two of them are known from a surface context discovered by M.A. Kiryak in 1989 near Mount Kymynyikei in the Vankarem depression, Northern Chukotka (Kiryak 1989:Fig. 6). Due to the morphology, one of the cores could be defined as a double-tortsovy core made of stone slabs or a flattened piece of raw material. Its characteristics fully correspond to those of Zhokhov cores of the third group (microblade cores that have two separate flaking surfaces on two opposite edge facets and a single platform). Another one definitely resembles cores with two adjoining flaking surfaces (the second group of microblade cores from the Zhokhov site). A series of double tortsovy-type cores made of brown slate slabs is known from surface finds collected on the Paleolithic Igelkhveem XVI site in Eastern Chukotka (Dikov 1993a:46, Fig. 20:1–4). And finally, a single core that seems analogous to Zhokhov cores of the third group was found by Kiryak on the left bank of the Kolyma River 25 km downstream from its confluence with the Taskan River, a tributary of the latter (Kiryak 1983). However, it is difficult to advance an idea explaining the analogies: on the one hand, it could be evidence of Early Holocene migrations, or a feature of convergent evolution of microprismatic knapping technology; on the other, both the former and the latter are reflected in the Mesolithic material culture.

Comparative analysis of the bone and antler implements from the Zhokhov site with those of contemporaneous assemblages discovered in neighboring territories is difficult because very few bone or antler artifacts have been found in the Northeastern Siberian sites of the Mesolithic period. At the same time, a variety of bone and antler artifacts of different chronologies are well presented in Siberian sites on the whole (the major part of them is from Southern Siberia). Inset tools, or tools with grooves (they can sometimes be identified in this way) occupy a specific place among artifacts of this category if when discovered they provide an origin to the archaeological contexts and possibilities for consideration of technical and technological capabilities of the ancient population, such as their economy, adaptation strategy, etc. It appears that only the Siberian materials, including inset tools of a wide chronological spectrum beginning from the earliest items known from Late Paleolithic Kokorevo and Afontovo cultural complexes up to the most recent Eskimo patterns, which make it possible to see in proper perspective the evolutionary trends of these tools, which were first of all hunting equipment, and to recognize some general features of the cultural evolution in the entire region. Such research is confronted with difficulties—the publications are incomplete with standard descriptions of the artifacts and often lack good illustrations, or some of the materials are not available, parts being lost, as in the excellent collections from Okladnikov's excavations of the Angara River burial grounds, published in very brief form. It is worthy of note that many researchers do not pay attention to the most important parameters when describing inset tools such as groove shape, depth, and width of the groove, and the method of grooving, if it could be determined.

Though they are not abundant, inset tools are known from some Southern Siberian Paleolithic sites. The major part of them was collected in the Afontova Gora excavations (Auerbakh and Sosnovsky 1932) and from other Yenisei River sites studied by Z.A. Abramova (1979a, 1979b); single items were discovered in the Chernoozerye II site, Western Siberia (Petrin 1986); the Kurla (Shmigun and Filippov 1982) and Oshurkovo (Okladnikov 1959) sites, Baikal region; the Birusa site (Khlobystin 1972); the Maininskaya site, Main River (Vasil'yev and Ermolova 1983); the Berezovy Ruchei site (Vishnyatsky 1987), and in the Studenoye settlement, Trans Baikal area (Konstantinov 1983). There are grooved artifacts among the bone inventory collected at the sites that were recognized as bone settings for side blades because of the narrow, deep slots cut along the ruler, as well as grooved tools that most likely were not used as frames for side blades (Shmigun and Filippov 1982). Paleolithic bone settings of inset tools have a simple typology, including both bilateral and unilateral side-bladed artifacts. For manufacturing both the former and the latter, antlers and animal bones split longitudinally were used. Artifacts with side blades that were found in situ in the grooves are of special interest. Very few have been found: a dagger from the Chernoozerye II site (Petrin 1986) and a projectile point from the Kokorevo I site (Abramova 1979b). The insets were made of the medial parts of unretouched microblades varying from 3.5/3.6 to 25.5 mm long by 4 to 6 mm wide. The reverse position of the insets found preserved in situ in the grooves should be noted as a particular feature of the bilateral side-bladed tool from the Chernoozerye II site. Because certain data are absent, it remains unclear if an organic glue or pitch was used for fixing the microblades in the grooves. Nevertheless, V.T. Petrin (1986:60–62, Fig. 46) supposes some organic matter to have been used for that purpose, though he believes it was replaced later by calcareous sinter due to the local soil chemistry. The profiles of the grooves on these earliest side-bladed tools have elongated-triangular outlines or are V-shaped. Judging by the parameters of both the insets (width and thickness) and the grooves, one can assume the latter to be 2.5 to 3.5 mm deep and about 2 mm wide. The length of side blades is rather irregular.

The Mesolithic inset tools found in Siberia contain numerous artifacts belonging to different stages of Mesolithic culture. Except for the Zhokhov site, there are the Ust-Belaya stratified site (Medvedev 1971), the Ityrhei site (Goryunova 1978), Gorely Les (Savelyev, Goryunova, and Generalov 1974), Sagan-Nuge (Goryunova 1987), Verkholenskaya Gora (Aksenov 1980), the Belkachi I stratified site (Mochanov 1977), and Trail Creek in Alaska, Caves 2 and 9 (Larsen 1968). Inset tools are represented by fragments of both bilateral and unilateral side-bladed implements, and the original tools were not large. Most likely the major part of them was projectile points. The exact metrical characteristics of the tools are generally not published. Judging by the fragments published, the profiles and metrical parameters of the grooves are nearly identical to those of Paleolithic artifacts. The largest collection is known from the Zhokhov excavations (Pitul'ko 1991; Girya and Pitul'ko 1994; and Chapter III). Twenty-five frames of bilateral and unilateral side-bladed tools (preforms, reshaped tools, fragments, and intact tools) were found there, including items with microblades preserved in situ in the grooves. These are mainly hunting equipment, but other implements are interpreted as knives. It is worth noting that the parameters observed on other Siberian inset tools of the Mesolithic period correspond fully to those of the Zhokhov finds. The latter make it possible to suggest that there was a kind of standardization of manufacturing inset tools. It is most likely that a standard, or more properly a combination of general technological methods, occurred as early as the Late Paleolithic due to convergent evolution. Concerning the grooves, it can be said that they are basically deep and narrow, with elongated-triangular (V-shaped) profile, approximately 3 to 4 mm deep and 1.5 to 2 mm wide; the groove depth is constant—slightly shallow in the distal and proximal parts. Observations of insets in the grooves could leave one to conclude that they are made from the medial parts of blades. The best evidence of the latter is recognized on materials from the Zhokhov site. Technological analysis of the stone industry of the site shows that its purpose was mainly for manufacturing blades for insets (Chapter III). In general, it is possible to consider inset tools of the Mesolithic period to have been inherited from Paleolithic ones. However, the typology of Mesolithic inset tools is more developed, though such an impression might appear because of the lack of data on Paleolithic artifacts.

Concerning the typology of Mesolithic inset tools, it should be noted that needle-shaped projectile points of three-edged or rounded cross section, as well as both unilateral and bilateral side-bladed, occur in the Paleolithic. Bilateral side-bladed artifacts are known only from Trail Creek in Alaska, but projectile points of similar morphology have been found in the Siberian Neolithic in the excavation of Shilkinskaya Cave, the Trans Baikal area, and in the Onyess Grave, Amga River, Yakutia. However, some forms known from the Paleolithic—such as bilateral and unilateral side-bladed tools of more or less flattened cross section (or with the original cross section of bone preforms)—as well as large, massive unilateral convex points (the three-edged variant in the Zhokhov collection) remain the leading artifacts in Mesolithic assemblages. Both the fragmented and intact tools are of elongated triangular shape, although there is a dagger or unilaterally grooved spear point from Belkachi site with a leaf-shaped body transforming toward its base into a rectangular handle or stem.

It is worth noting that certain artifacts were discovered in the excavation at Trail Creek caves. These items of hunting equipment, though fragmented, might be defined as grooved implements strongly resembling those of Siberian Paleolithic sites.

Inset tools of the Neolithic and Early Bronze Age are well represented in many sites surveyed in Southern Siberia, Baikal (Okladnikov 1950, 1960, 1974, 1976, 1978; Konopatsky 1982), and the Trans Baikal region (Okladnikov and Kirillov 1980; Grishin 1981; Ivashina 1979; Vetrov 1982, etc.), Yakutia (Fedoseyeva 1968; Arkhipov 1989; Kozlov 1980; Mochanov 1977). In generally characterizing these tools, one can see two definite tendencies in the further evolution of inset tools.

The first, defined most clearly in the Neolithic and Bronze Age of the Baikal region, is the rapid replacement of unretouched microblade insets by retouched ones in the sequence "unretouched microblade insets—partially retouched blade insets—fully retouched insets" in the evolution of hunting equipment, while the evolution of cutting tools is proceeding toward compound tools with a single, fully retouched large stone inset. These implements are significantly larger than the Mesolithic ones. Obviously thin bifaces, well represented in the Late Neolithic of Yakutia (Fedoseyeva 1982) and in other regions as well, are the side blades of compound tools such as those described above. Unfortunately, coherent transformations of shape (profile) and the size of the grooves have not been recognized inasmuch as these materials are very poorly published and no parameters can be referred to.

At the same time, another tendency observed in the succession of Siberian inset tools of Paleolithic-Mesolithic tradition is based on the use of unretouched microblades as the simplest insets for compound tools. Evidence for this is known from the Onyess (Kozlov 1980) and Dzhikimdinsk Grave sites (Arkhipov 1989) and from the Tuoi-Khaya burial ground (Fedoseyeva 1968). Though the parameters of the grooves are noted in very few cases, the descriptions are generally informative. Thus, I can refer to the Tuoi-Khaya materials reported by Fedoseyeva, who notes that unretouched medial parts of microblades were used that project 1 to 2 mm out of the grooves, which are 4 mm deep and 1 mm wide (Fedoseyeva 1968). Projectile points discovered in the Onyess Grave site had tip insets made of almost whole microblades, from which the proximal parts with the bulb of percussion were broken (Kozlov 1980). Artifacts of just such morphology were found by Okladnikov (1960) in the mixed subsurface context of Shilkinskaya Cave. Of special interest are finds of bilateral side-bladed inset tools excavated at Tuoi-Khaya (Fedoseyeva 1980), the Molodovsk burial ground (Kirillov and Verkhoturov 1985), and microblade insets found in situ in a decomposed bone setting of a compound tool in a grave discovered at Stary Vitim settlement (Vetrov 1982). All of these tools had the insets placed in grooves in the reverse position, that is, if the microblades comprising one edge are put into the groove with ventral surface up, the insets of the other are turned over and placed with dorsal side up. At least some of the finds are dated to the Late Neolithic or Early Bronze Age; the Vitim burial is the most recent, being dated to the Early Iron Age based on the material in the assemblage (Vetrov 1982).

In this way, finds of compound tools known from Siberia make it possible to conclude that they existed for a very long time. Occurring for the first time as early as in the Late Paleolithic, they gradually developed up until the Iron Age, being rather conservative in typology during most of their evolution. The Paleolithic bilateral and unilateral prototypes survived successfully and became more perfected. Numerous finds show that needle-shaped projectile points of both types occurred in the Mesolithic by at least 8000 BP. Later, in the Neolithic, they became a wide-spread type of hunting equipment. A general evolutionary trend in hunting equipment can be seen in Southern Siberia, at least as found in the gradual replacement of bilateral forms by compound tools with single big side blades in the above-mentioned sequence. That is, a transition is observed from inset tools with microblades to proper compound tools composed of bone settings and stone blades. The diverse thin bifaces, well represented in Late Neolithic sites, are undoubtedly elements of such constructions. According to the published data, the absence of a glue mass in the grooves is a particular feature of Siberian tools—in contrast to both Eastern European and Ural items. It can be said that as a rule the grooves are found to be deep and narrow on Siberian inset tools, and that is especially true for early types. The grooves are elongated-triangular in profile (V-shaped). The insets were probably fixed in them by drying the bone setting, which had been soaked or steamed out previously for successful placement of blades. At the same time, it is revealed that inset tools from Eastern European sites are generally characterized by rather wide grooves with a flat bottom, and with trapeziform profile in some cases (Oshibkina 1983). Perhaps these technological peculiarities could be considered regionally specific.

Finally, it is necessary to note the element of technology (or both technology and morphology) characteristic of large bilateral side-bladed points (I believe them to be spear points, though some researchers call them daggers); it is the reverse position of microblades. Tools of such morphology are distributed broadly both chronologically and geographically (the most ancient artifacts are known from the Chernoozerye II site on the Irtysh River in Western Siberia, where they are dated to 13,000 BP; the most recent were discovered at Stary Vitim settlement on the Vitim River in the Lena Basin in Eastern Siberia, belonging to an Iron Age layer from about 2000 BP. That is, this tradition survived over a period of approximately 10,000–11,000 years). Analogous implements are known far to the west—for instance, in the Late Paleolithic Talitsky site, Ural area (Gvozdover 1952), and in the Mesolithic Oleneostrovsky burial ground, Karelia (Gurina 1989). Such a position of microblades was probably functionally needed for a purpose affecting balance or strength or both, or for improving the effectiveness of the tool, etc.

Traditionally (primarily due to excavations of Eskimo sites) it is estimated that the bone-antler-ivory inventory, and hunting equipment in particular, is more or less decorated, being connected with such things as rituals, magic, ideology, etc. Nevertheless, inset tools from Siberian sites (except Eskimo settlements) are poorly decorated, irrespective of the age or geography, if they are decorated at all. Lines drawn (cut, engraved, or perforated) along the axis of tools are found which could be substituted sometimes by the groove of the original relief of the bone surface. This is the only common feature. Few deviations from this normal sparse style are known—such as the perfect ornamentation of the dagger from the Chernoozerye II site, the perforating zigzag on the projectile point from Cave 9 at the Trail Creek site, and a fragment of a tool that is believed to be a dart point. The latter is decorated with a series of small diagonal incisions in the base, but at the same time it could be a functional or technological element and not an ornament.

Artifacts of fossil mammoth ivory occupy a particular place in the inventory of the Zhokhov site. Objects made of mammoth ivory are found infrequently at Pleistocene sites of Northeast Asia. As a rule, these are large ivory flakes that were not further processed (Mochanov 1977:Figs. 25:3–7; 26:4–5). Inasmuch as use-wear traces have not been examined, I cannot discuss the function of such tools. Both the known ivory and bone artifacts come mainly from the famous Berelekh site (Mochanov 1977:81–83). Tools made of ivory flakes were also found. The latter are commonly discussed as dart points (Mochanov 1977:Fig. 58:9, Dyuktai Cave, st. VIII, ca. 15,000 BP) or spear heads (Mochanov 1977:Fig. 24:38, Berelekh site, ca. 13,000 BP). An excellent hunting spear head carefully made of ivory was also found at the Berelekh site. The tool appears as an elongate, rounded in cross section rod 940 mm long and about 25 mm in diameter (Vereschagin and Mochanov 1972:Fig. 4). The use of other parts of mammoths' skeletons (ribs and humerus bones) has been revealed at other sites such as Ust-Mil II, Ikhine II, and Berelekh. Evidently the natives used the bones and ivory of taken animals, though it is disputable for the Berelekh site inasmuch as it is quite possible that Berelekh people used the dead bodies of mammoths and other animals that had fallen prey to a natural trap—an oxbow of the Berelekh River, where a great quantity of Pleistocene faunal remains were accumulated (Vereschagin 1971:93). It is interesting in this connection a mammoth tusk with to point out a mammoth figure engraved on it that is supposed to have been discovered near the Berelekh site; in discussing the object some scholars have assumed that the drawing was made by an ancient artist who had seen a frozen mammoth's dead body exposed at the precipice of a riverbank.

It should be noted that the problem of the possibility of using fossil mammoth remains is still extremely important since the bone remains of mammoth and other Pleistocene animals are abundant in Northeast Asia and might be used at any time up to the present.

Excellent examples of the use of fossil mammoth ivory (and perhaps other bones) were discovered in excavating the Zhokhov site: bilaterally and unilaterally grooved points, a large series of massive pick-like tools, a side scraper, and a skinning knife (see Chapter III). The last two were made on large ivory flakes, which was determined in trace-analysis studies of the material. Unfortunately, the Berelekh finds—of exactly the same morphology (Figures 61, 62)—were never examined in this way.

Summarizing observations of rare ivory artifacts known from Late Pleistocene archaeological sites studied in Northeast Asia on the one hand, and the Early Holocene Zhokhov site on the other, allow the following possible conclusions:

1. The dorsal surfaces of the preforms (ivory flakes) commonly retain the natural ivory exterior; the flakes are short and wide, i.e., their outlines are close to extended discoid or oval. Obviously, both specially prepared and unprepared pieces of ivory were used. The striking platforms might or might not have been prepared; naturally split surfaces of the ivory (some kind of cleavage) could also be used, particularly on fossil tusks. The flakes were knapped off with powerful lateral strokes. In contrast to the Old Crow industry (Bonnichsen 1979), bone artifacts with a core morphology have not been found in Northeast Asia;
2. The ivory flakes have no traces of additional processing in most cases, though some artifacts manufactured from ivory flakes were carefully retouched like stone tools;
3. In the processing of large tools (e.g., hunting equipment, pickaxes, etc.) the methods of cutting, planing, and grinding (the last for final processing) were used extensively;
4. The methods of treating fresh ivory (i.e., ivory from prey) and fossil ivory (surface or excavated finds) seem similar. Thus, there are some traditional principles of use and treatment of this raw material that survived for a very long time, beginning as far back as 15,000 BP.

Two more categories of bone-antler artifacts are in the inventory from the Zhokhov site; they also have analogies of a broad chronology, found in the Neolithic and more recent assemblages. First, these are pickaxes of antler (Figures 43, 44), close analogies to which are known from Eskimo sites. Even though the latter differ in insignificant details from the former, they are both of the same general morphology and function. Another category includes T- or L-shaped handles of antler that were supposedly used for hafting stone chisels or axes (Figure 47). Similar articles are known from Northern Yakutian Neolithic sites such as Rodinka Grave, dated to approximately 4000 BP (Kistenev 1980:87, Table VI:5), and the Nizhne-Taloudskaya site (Mochanov, Fedoseyeva, Konstantinov et al. 1991:60, Table 118:8), the age of which is assumed to be no older than 6000 BP (the mixed context discovered there is defined as Neolithic in general). At the same time, a fragment of such a tool was found in the prehistoric (about 500 BP) layer of the Thule culture in the Walakpa site (Stanford 1976:90, Plate 113:i).

Among the wooden artifacts discovered at the Zhokhov site, a large fragment of sledge runner is the most interesting. Some distinct features of the excavated fragment show that it is part of an extremely advanced construction, which differs sharply from the Northern European (Berg 1934) and Russian (Burov 1974; Eding 1929) peat-bog sledge runners dated to 8000–6000 BP. The latter are rather primitive and discussed by archaeologists as flat sledges or the keel boards of boat-shaped sledges similar to Lapp sledges. Constructions with uprights are usually assigned to later times. Some general types of the built-up sledge described by anthropologists and polar researchers are well known in the circumpolar area (Bogoraz 1992:43–44; Chikachev 1991:72–73; Levin 1948:89–94). The mapping of bog-finds known in the European North propelled Georgiy Burov (1981:164, Fig. 8) to the idea that sledge transportation appeared in Northern Europe in the Mesolithic and gradually improved in this area throughout several millennia without any diffusion into neighboring territories. Nevertheless, it is obvious that the secret was very widely known, and the advanced built-up construction of Zhokhov sledges makes it possible to assume that ideas of sledge construction progressed for a very long time. Though direct analogies cannot be pointed out, some structural elements of the sledge runner from the Zhokhov site are surprisingly close to Eastern Siberian dog sledges used during the last two centuries by natives and Siberian Russians (Levin 1946:Fig. 16; Mason 1894:Figs. 244, 245).

But did the hunters use any animals for towing the sledge? Or did they pull the sledges themselves? We suggest facts, discussed below, that make it possible to assume that dog traction was practiced by Zhokhov natives, though dog bone remains and parts of a sledge cannot be considered indisputable evidence.

The age of dog traction is usually considered rather late. For example, in the American Arctic it is dated to about Thule times or later. Scanty archaeological materials known from Russian Eskimo sites show that dog traction here cannot be dated to more than 700–800 years ago, though perhaps it was invented earlier. The only real evidence for early dog traction in the Arctic was from the Ob' River estuary. A dog with harness is depicted on a bone knife handle excavated from the famous Ust-Polui site (Moshinskaya 1953:85, 86, Table VI). The materials are dated no earlier than the first to third centuries AD (i.e., 1700–1900 BP). Harness equipment (toggles, swivel blocks) and features of sledges (bone pins or nails and antler sled-shoes for protection of the wooden runners from contact with the ground) dating to 1000–1500 BP were found at the Cape Vhodnoy and Karpova Bay sites (Pitul'ko 1991:27–31, Fig. 4). But Arctic peoples, who had to maintain constant mobility, had to invent the dog traction earlier.

Unfortunately, the archaeological materials yield no direct evidence of dog traction such as parts of a harness (or pictographs, figures, etc.), but dog bones were found during the excavations on Zhokhov Island.

Several bones were excavated. There are two fragments of mandibles (probably from one animal), a fragment of maxilla, an isolated fang, and postcranial bones: an intact radius and tibia, and zygomatic bone. These remains undoubtedly belong to canines. The bones certainly exceed in size the same ones from the Arctic fox skeleton, and appreciably less than those of a wolf. To illustrate this assumption we refer to the real dimensions: the radius bone is 175 mm long, the tibia 190 mm. The same parameters measured on the bones of a wolf are about 200 and 220 mm respectively. Fossil dogs are a rarity in Siberian Final Pleistocene and Early Holocene cultural deposits, and the only excavated dog remains we can refer to are from the Final Upper Paleolithic Ushki site located in the central region of the Kamchatka Peninsula. The fossils (both the skull and the postcranial bones) were poorly preserved. They were examined by N.K. Vereschagin (1979:10–19), but due to the preservation only the general proportions of the cranium were described, which is useless for comparative analyses.

The fragments of dog jaws from the Zhokhov site have some distinguishing features indicating that dogs of this kind were not far from their wild ancestors. The jaw, when observed in profile, looks less curved than the standard dog jaw. The first molar is massive, but the dental system is weakly constructed on the whole. The teeth are not pressed close to one another, and the fangs are small.

For features of domestication to definitely be identified, the dog remains from Zhokhov Island were compared with the skulls of native huskies that were kept by the Yakuts over the last quarter of 19th century. The skulls, collected more than 100 years ago, are preserved now at the Institute of Zoology in St. Petersburg and are of the original genotype, dated to the period when cross-breeding of the aboriginal and imported dogs had not yet taken place. They are very valuable material for comparison (Pitul'ko and Kasparov 1996).

The teeth range of the jaw from the Zhokhov site (measured from the front line of the fang alveolus to the rear point of the alveolus of M1) is 101 mm long. The average dimension of the teeth range on wolf skulls from the Lower Indigirka River area is 131.3 mm, lim 124.2–139.0, N = 8 (Vereschagin 1971:151). For Northern Yakut huskies it is 99.8 mm long (average), lim 88.4–107.1, N = 7. The crowns of M1 are large on the fossil dog jaw from Zhokhov Island. They are 25.8 and 26.2 mm. The average length of the M1 crowns in the groups is 27.5 mm (lim 27.3–31.2, N = 8, wolves) and 21.5 mm (lim 20.0–24.1, N = 7, huskies) respectively. Discussing parameters with progressive dynamics clearly indicates the process of domestication. To illustrate we can refer to dog remains found at the Cape Baranov Eskimo site (Eastern Siberian Arctic), which are much younger than the Zhokhov dog but 1,000 years older than the Yakut huskies; the M1 crown is (average) 20.7 mm long, lim 18.5–22.7, N = 6 (Vereschagin 1971:151).

The Mesolithic dog found on Zhokhov Island unexpectedly looks similar to dog remains discovered far from the island. The dimensions and outlines of the jaws are close to one another. Though the finds are rare we can point out dog bones excavated from the Koksharovsko-Yur'evskaya site in the Trans-Ural area (Serikov and Kuzmina 1985:89–92) and fresh data concerning the discovery of a buried dog skeleton from North America dated to about 8500 BP (Morey and Wiant 1992:224–229, Fig.). Unfortunately the parameters of the jaws are unpublished, but scaled photo illustrations allow understanding that the index M1 crown length to tooth row length is about 23 %, while the Ural dog is 22%, Yakut huskies 21.5 % (N = 7), and the Zhokhov dog 25.5 %—more than the index (22.1 %, N = 8) measured on the wolf skulls from Indigirka (Vereschagin 1971). These facts demonstrate that the Mesolithic dog from Zhokhov Island occupies the intermediate position between wolf and domesticated dog.

To complete the description of dog finds from Zhokhov Island, we must note a large quantity of well-preserved dog feces excavated from permafrost soil. They were located on a small rounded section and contained reindeer hair with half-digested fragments of phalanges or sometimes small pieces of corneous hoof covers. It is well known that such concentrations appear in the summer when draught animals are tied up individually to posts.

To summarize, we note that the natives of Zhokhov Island had dogs, which assisted them in the dangerous hunt for bears. Doubtless they knew the advanced construction of the built-up sledge and probably draught animals for mobility. Consequently, it is quite possible that the animals were for this purpose.

But there is no way to ascertain now that dog traction was really practiced in the high Arctic as early as 8000 BP.

# CHAPTER V

## Early Man in Arctic Ecosystems: Environmental Dynamics and Changeability of Subsistence Models

Inasmuch as it is quite obvious that the history of mankind is a permanent sequence of adaptations (it could be applied especially to the history of human occupation of the Arctic), a look back at it would be a good thing to do in the concluding chapter.

Geological and geomorphological research undertaken in Fennoscandia within recent decades have shown that the Scandinavian ice sheet did not reach the easternmost area of Northern Fennoscandia during the last glacial. Some territories, such as a narrow corridor extending along the western Norwegian coast and a part of the Murmansk coastal area with Rybachy, Sredny, and Svyatoy Nos Peninsulas, were probably ice free (Kholstedal 1957:21–23). As shown in Chapter II, the area covered by the Scandinavian glacier was almost completely deglaciated by 9000–8000 BP. At the same time the Ponoy Glacier, occupying the inner part of the Kola Peninsula, existed for a long time, slowly melting, and the territory was deglaciated only at the end of the Early Holocene. It is believed that the main part of the Ponoy depression remained unfit for both animal life and human occupation even much later (Armand and Nikonov 1963:55–60; Blazhchishin and Kvasov 1963:55–60; Vakorin and Kuptsova 1975:68–73). The existence of the Ponoy Glacier strongly affected natural conditions in Eastern Fennoscandia. Thus severe natural conditions occurred on the south coast of the Kola Peninsula.

The early Mesolithic population of Northern Europe survived under complex, fluctuating natural conditions that were characteristic of the late Pre-Boreal and Boreal periods. Consequently, the environmental features of the terminal glaciation and the Post-Glacial are of great importance for studying the history of human occupation in the area under consideration. Thus, it is supposed that both the Late Mesolithic and the Neolithic, coinciding in that territory during the Atlantic and Sub-Boreal periods, were the most favorable time for ancient Northern Europeans. The climatic optimum, suggested to have started in the second half of the Atlantic, was characterized by a warming trend. Thus, forest vegetation shifted far northward. Sub-Boreal conditions were also favorable on the whole for human habitation (Budyko 1977:107). The cold fluctuation, covering the end of the second and the third phases of the Sub-Boreal (the Early Metal Period in archaeological terms), slightly affected the population of the area. However, both the cold climatic trend, which predominated later—coming to the maximum in the middle of the first millennium BC, and the rising humidity contemporaneous with it (Khotinsky 1977:147)—appeared to be important and effected some changes in native economy.

Natural fluctuations caused the Post-Glacial crisis in reindeer hunting in Central Europe and the Pre-Boreal migrations of the Arensburg and Svider cultural groups respectively. But if the Arensburg population moved primarily northward, the Svider people migrated in an eastern or northeastern direction (Dolukhanov 1982:3; Kol'tsov 1979:15–25, 1984:74–85; Shumkin 1990:88). The cultural influence of the latter can be recognized as far as the Ural Range.

Archaeologically this process is reflected in the formation of the Komsa, Fosna, and Suomusjarvi cultures studied in Fennoscandia. Bearers of the first two, who were mainly descendants of the Arensburg population, reached Fennoscandia by moving across the land bridge that had appeared between western Scandiavia and the mainland in the Pre-Boreal due to isostatic movements. Both the Komsa and the Fosna people initially occupied the littoral zone of the southern, western, and southwestern coasts of the Peninsula, slowly moving northward along the coast and farther, to the eastern and southeastern coastal area. The inner part of the region remained uninhabited for a long time and became more or less populated in the Late Mesolithic. The region of Fennoscandia is considered to have been occupied completely only in the Late Neolithic (Shumkin 1984:3–18).

Archaeological research of Northern Fennoscandia has produced diverse and valuable material showing the flexibility of the aboriginal cultures, characterizing different adaptation strategies created under natural conditions. The balance of the food sources in use during the early stages of human occupation of Northern Fennoscandia were changed several times owing to changes in the faunal assemblage and the progress in development of hunting equipment and game strategy. Fishing is supposed to have been less important in the early stages, because sparse ichtyofauna were found in the periglacial lakes of the inner regions of Scandinavia. Most of the lakes totally lacked fish (Indrelid 1975:1–18). Moose and reindeer, which appeared in Fennoscandia no later than during the Allerode, can be considered the traditional game species hunted by the region's ancient natives. These two species, as well as sea-mammals—various seals and Atlantic walruses—were the main food sources over a long period. Undoubtedly, other mammals and birds were hunted too, and gathering was in practice. But the above-mentioned species were the most important sources, providing all the food and raw material necessary for subsistence.

Observations made in considering the composition of the Mesolithic tool assemblages, the thickness of the cultural layers discovered at sites, and the planigraphy and topography of the latter enable discussion of the Mesolithic peoples of Northern Fennoscandia as nomadic marine gatherers. Keeping in mind that the region under consideration is one of the areas that is richest in marine resources, we can suppose the above-mentioned subsistence pattern to have been rather stable. It is most likely that the early inhabitants of the area primarily exploited the productive resources of the littoral zone, supplementing the results by gathering and bird and reindeer hunting during some seasons, but there is no evidence of clear seasonality in the early Mesolithic economy. All the early Mesolithic sites are located in coastal areas, and none have ever been found in the interior regions. Vladimir Shumkin suggests that the population that entered Northern Fennoscandia in the early Mesolithic can be described as "specialized marine gatherers" (Shumkin 1988).

It should be noted that specialization indicates the main focus of the subsistence pattern; it does not mean that hunting, fishing, or gathering was the sole activity. It is very doubtful that such an economy has ever existed since the economy of every group of northern peoples was multi-faceted, and the latter was the only way to survive in the Arctic (Krupnik 1989:6; Chernov 1980:219).

The peopling of interior Northern Fennoscandia began in the late Mesolithic, after complete deglaciation of the area, which became occupied by natives in search of new food sources. The subsistence strategy of this population was focused on the exploitation of large mammal fauna of the forest supplemented by gathering and probably by primitive fishing practiced by chance and based on hunting methods. The sites of this period, discovered both in the interior regions and on the coast, appeared to be very close to each other when compared according to the main parameters such as thickness of cultural deposits, square of the area covered by the latter, and implements and technology. These common features can be recognized as evidence of seasonality in a native economy based on marine resources in summer and continental ones in winter. Perhaps some groups were of this kind, but adaptation based on seasonal migrations is thought to have been more characteristic for Southern Scandinavia (Mikkelsen 1978:78–119), while Northern Fennoscandia remained an area of bilinear evolution of subsistence strategies practiced by a population that occupied the interior and coastal regions up to Neolithic times (Shumkin 1984:3–18).

Further differentiation among native adaptations is recognized in the Late Neolithic, when these two tendencies were distinctly realized in the appearence of subsistence patterns based on continental and marine resources. Site locations, faunal remains discovered in the cultural layers of the sites, and tool assemblages show that the population of the interior regions of Northern Fennoscandia became proper forest hunters and fishermen in contrast to the sea-mammal hunters populating the coast, though the latter hunted other animals by chance and practiced fishing and gathering. This proper Arctic sea-mammal hunting adaptation flourished later, during the Early Metal period. The material culture of this period, known from excavations of coastal sites, demonstrates a specific adaptation model chosen in former times. There is great diversity in hunting equipment, which is represented by arrow and spear points and harpoons of both the regular and toggle types. Greenland and ringed seals, Atlantic walruses, and cetaceans (rarely) were the main hunted prey, as shown by the faunal remains discovered during excavations. But it is obvious that even during this period terrestrial mammals such as moose, reindeer, beaver, Arctic fox, and polar bear—whose bones have been found—were a part of the hunted prey, and fishing also played a role.

The living sites of sea-mammal hunters known along the Arctic coast of Northern Fennoscandia are thought to have been of long-term occupation, rather large, with thick cultural layers containing a great number of faunal remains. The locations chosen for the sites are still of extremely high biological productivity, which was determined by the necessity to use diverse resources (Krupnik 1989:40–46). According to ethnographic observations, the coastal Saami used a practice well known by the Eskimos, that of exploiting food sources found in a narrow strip along the coast line and a water area 5 to 10 km wide. The most intensively used areas surrounded the site locations but did not exceed an area of more than 3 to 10 $km^2$. The high density of occupation discovered in some regions, such as Varanger Fiord and Drozdovka Inlet, can thus be explained. It is estimated that the effectiveness of the sea-mammal hunting exceeded 10 to 15 times the regular productivity of subsistence patterns practiced by groups populating the forest zone and twice that of farming cultures (Broadbent 1979:250–259). These observations make it possible to agree with the opinion that communities of sea-mammal hunters can be compared in some sense with tribes using a production economy (Renouf 1984:18–28).

The flourishing of native sea-mammal hunting in the early phase of the local Iron Age suddenly collapsed, supposedly because of environmental changes. In all probability, a drop in temperature took place in the first millennium BC that affected the migrations of sea mammals, forcing them to choose other routes and rookeries farther northward along the Arctic coast of Scandinavia. The disappearance of native sea-mammal hunting on the coast of the Kola Peninsula is dated to this period, while that of Northern Fennoscandia disappeared sometime later. The unfavorable natural trend, which was of catastrophic character for the coast people, forced them to once again adapt to interior tundra regions.

There are evidently some grounds for something like the idea advanced by K. Karpelan (1979:141–151), who suggests that the hunting groups who populated the area in the Iron Age were involved in trade connections with the population of the southernwestern regions of Scandinavia, whose social development and productive economy were much higher than those of hunters peopling the North. Depending on the import of various iron products (both tools and others), they were forced to become more active in fur hunting. The latter was conducive to modifications in and disappearance from the traditional culture of the natives of Northern Fennoscandia. It is supposed that reindeer breeding was introduced to the local culture in the middle of the first millennium AD and later (beginning in the Middle Ages). The subsistence pattern was modified to that of some kind of "late hunters" (in Krupnik's words) based on seasonal cyclic movements, when reindeer were used mainly for transportation.

The second area comprising the western Arctic—territories of the extreme Northeastern European and adjacent Northwestern Siberian regions (the Yamal Peninsula), which could be called the polar Trans-Ural zone—was characterized by another kind of cultural and economic development. The initial occupation of extreme Northeastern Europe, which began in the Paleolithic, is thought to have been interrupted by the Valdai Glacial. Concerning the polar territories, it can be said that they became populated in 7000–8000 BP (Vereschagina 1989; Kanivets 1976). Climatic and geographic reconstructions covering this period show that rising temperatures (the summer average is believed to have exceeded the current one by 1.5 to 2°C) and humidity occurred in the region's polar areas beginning approximately 8200 BP. Favorable climatic trends that are recognized as conditions of the Holocene climatic optimum caused large scale environmental changes, with forest vegetation shifting far northward, reaching the Arctic coast in some places. Meanwhile the tundra zone was less represented (Avenarius and Muratova 1978:47; Pyavchenko 1952:127; Khotinsky 1977:149–164). The landscape changes undoubtedly affected the dispersion of the primary game species important for human subsistence. Some areas, especially the reindeer area, shifted northward. Evidently the population that occupied the tundra and forest-tundra zone of extreme Northeastern Europe in the Mesolithic was not very large and survived by exploiting traditional food sources such as reindeer, birds (especially molting geese), and fish. The topography of the sites located here and there along small rivers and creeks, and near open lakes where primitive fish traps similar to that discovered in the Mesolithic First Vis Peatbog site (Burov 1966) might have been constructed, show that fishing was in all probability being practiced but did not play a significant role in the native economy. Stone implements represented mainly in surface contexts include stone points of the Post-Svider type, flint insets made of blades and microblades, burins, etc., which are somewhat similar to artifacts known from the Volga-Oka and Kama River regions (Vereschagina 1989:11; Volokitin 1988:19–23). Correspondingly, the Mesolithic population of extreme Northeastern Europe is believed to have been descendants of tribes who occupied the above-mentioned regions near the Pleistocene-Holocene boundary.

Further climatic and environmental changes that took place during the Sub-Boreal and Sub-Atlantic periods were of less importance for subsistence patterns employed by the groups populating the area, or at least they did not cause sharp changes that can be archeologically recognized. At the same time the mid-Sub-Boreal rise in temperature, resulting in the deciduous forest vegetation repeatedly shifting northward, could have caused new intensive migrations northward from neighboring southern territories (Khotinsky 1978). It is possible that evidence of this process can be found in the relics of the Chuzhyayol culture, some of which are undoubtedly of southern origin. In the view of V.S. Stokolos (1987), they can be traced back to the Late Neolithic of the Kama River area, but in my opinion they are instead evidence of the Sub-Boreal cultural connections or interactions that took place in the region.

As for the Siberian Northwest, it is most likely that this area remained unpopulated for a long time, though the natural conditions that appeared near the Pleistocene-Holocene boundary were favorable (see Chapter II). The territory is lacking in early archaeological material, and one can suggest that there were some periods when Mesolithic hunters penetrated far northward, at least up to the Arctic Circle. The only Early Holocene site—Korchagi—is in the polar Siberian Northwest (Khlobystin 1982). It is supposed that the region became permanently populated in 3000–4000 BP through the migrations of bearers of the Taz, Sortynya, and Ortino cultures (Khlobystin 1982; Khlobystin and Lashuk 1986). The latter (spread from west to east from the Pechora River to Ob' Bay), the most significant phenomenon in the history of the region, strongly affected further cultural evolution in the polar Trans-Ural zone. Judging by the topography of the sites and tool assemblages, one can suggest that the subsistence strategy of the region under consideration was of the standard, conservative kind well known in Polar Regions. The groups populating the area were mobile reindeer hunters who supplemented their main activity with fishing, gathering, and bird hunting. The locations chosen for Neolithic sites and those of the Early Metal period are on small rivers, lakes, and oxbow lakes, which remain the most popular places for fishing and for hunting molting geese.

The question of the development of native sea-mammal hunting in the coastal and island territories of the Polar Trans-Ural zone appears to be very important inasmuch as the area has an abundance of marine resources. Until recent years archaeological evidence of indigenous maritime cultures was limited to material from Yamal, investigated by V.N. Chernetsov (1935), and from relics of the Ust-Poluy culture (Moshinskaya 1965). I.I. Krupnik (1989:179–182) supposed that the local type of maritime adaptation has existed there for some time. The above-mentioned finds have long been compared with Eskimo materials, although the emergence of various elements of maritime subsistence systems in the Far Northeast of Europe in Russia and the northern parts of Western Siberia resulted from convergent courses of cultural evolution.

Concerning the western Arctic regions under review, the main questions can be formulated as follows: (1) the age of initial assimilation of the elements of maritime adaptation; (2) the role of these elements in traditional survival systems and the way they were controlled; (3) ethnic processes and their role in the variability of subsistence systems.

Within certain limits of reliability, recent data indicate the emergence of elements of a maritime subsistence system in the second half of the second millennium BC, i.e., approximately 3500 BP. Specifically referred to in this connection are the Maly Bolvansky Nos sites I and II in the northeastern part of Vaygach Island; their topographic locations can only be explained by the utilization of maritime resources (Pitul'ko 1988). Maly Bolvansky Nos I and II are linked to the spread of the Ortino culture in the Polar Trans-Ural zone, which in its final stage was influenced by the Garin-Bor culture of the Kama region (Khlobystin 1973).

Systematic research of the area directed by L.P. Khlobystin in the 1980s resulted in the discovery of sites dating to the first millennium AD, where maritime hunting was a prominent feature of the economy (Khlobystin 1985, 1986; Khlobystin et al. 1986). According to Krupnik, this material constitutes definitive evidence of the wide distribution of maritime subsistence systems in the region as well as the prehistoric existence of an original center of maritime adaptation (Krupnik 1989:179–182). Together with A.M. Murygin, he places in the same broad context the materials of the sacrificial site of Heibidya-Peddar; the present author strongly disagrees. Murygin claimed that the site belonged to a people involved in maritime hunting, citing as evidence pictures of sea animals scratched on a bronze mirror and a flat cast zoomorphic figure (Krupnik 1989:181). Unfortunately, I cannot share Murygin's optimism concerning these pictures (Murygin 1984); it is obvious that the images are of fish and the zoomorphic figure depicts a small furry animal, probably a lemming. The latter feature incorporates ancient indigenous beliefs.

Archaeological materials important for the discussion come from a shrine at Sirtya-Sale cape in the western coast of Vaigach Island (Khlobystin 1985) and another famous shrine at Diakonov (Bolvansky Nos) cape, which is the southernmost point of the same island deep protruding into Yugorsky Shar sound that separates Vaigach from the mainland (Khlobystin 1986). Rich archaeological collections obtained from these two sites do not in any way confirm the notion that maritime hunting had a central role in the indigenous economy—Samodic or Pre-Samodic—at least in the last millennium.

Discovered in 1985, Sirtya-Sale sanctuary was fully excavated same year (Khlobystin 1985). Although it is small, this site yeilded a number of interesting bronze artifacts including masks, human and animal figurines, decorations with a popular motif of fantastic creatures, personal ornaments, iron tools and animal bones. These all served as offerings. Judging by known age for some of the artifacts, it can be concluded that the shrine was started in XI–XII century

AD—i.e., roughly about 1,000 years ago or a little bit earlier, and did not last long. None of the arifacts can be attributed to sea-mamml hunting. Unearthed fauna remains are not numerous and clearly dominated by reindeer bones.

A huge shrine at Bolvansky Nos was probably started even earlier, at around 1,500 years ago, and existed to the middle of the XIXs century when it was destroyed because of spread of the Christianity. A big portion of the site was excavated by Khlobystin in 1985–1987. Site yeilded a number of artifacts (bronze, iron, and bone) and a numerous faunistic collection. These materials as well as that of Sirtya-Sale site show multi-directional cultural/trade connections between the people inhabited the area. Thus, a number of artifacts find the closest match in analogies known in Western Siberia (Low Ob River), Northern Urals, Kama River, and even in Early Medieval NW Russia (Novgorod, Ladoga). However, there are no depictions of sea animals, or any finds of maritime hunting equipment. Of the faunal remains, at least 60–70% represent reindeer, although bones of sea animals have also been found. In any case, these sacrificial complexes belonged mainly to reindeer hunters, who later turned to reindeer breeding.

At the same time, of major importance for the subject at hand are the materials excavated from the Karpova Bay site on Vaygach Island and the Cape Vkhodnoy site on the shore of Yugorsky Shar Sound (Khlobystin and Pitul'ko 1996; Pitul'ko 1991h). The latter demonstrate the same ratio between sea and land hunting activity. The sites were undoubtedly linked to sea mammal hunting, which is confirmed both by the faunal remains and by the finds of items of maritime hunting equipment (ice shoes, harpoons). Still, other animals are well represented: reindeer, polar bear, and arctic fox bones were found as well as those of various birds (Pitul'ko 1991h).

Finds from Cape Vhodnoy demonstrate that in one form or another maritime hunting played a definitive role in the indigenous economy of the first millennium AD. This activity maintained its importance even after the arrival of new settlers, as indicated by the results from the Karpova Bay site. But we do not know just how important this role was or the actual success or efficiency of local maritime hunting. Did it provide a permanently settled way of life in the coastal areas of Northwestern Siberia and in the Far Northeast of the European part of Russia? Some authors give affirmative answers to this question (Krupnik 1981, 1989). Thus Krupnik distinguishes two variants of maritime hunting in the western Arctic, namely, a culture of settled hunters and the seasonal sea hunting of nomadic tribes of the tundra (Krupnik 1989:181). Archaeological results, however, show that the Far Northeast of Russia in Europe and the northern parts of Western Siberia never attained a level permitting the formation of settled maritime cultures. It is more likely that throughout the history of the area maritime hunting was mainly seasonal, and correspondingly more or less successful. It appears that where maritime hunting was consistantly effective, permanent seasonal hunting camps were established, such as those discovered by V.N. Chernetsov and the settlements of maritime hunters mentioned by various travellers of the 16th and 17th centuries (Van Linskhotten 1915; Lamartinier 1912; Chernetsov 1935). Settlements of this kind existed in the Arctic regions from prehistoric times (Khlobystin 1972; Pitul'ko and Makeyev 1991). Recent results offer precise evidence of the seasonality of maritime hunting. As for the Ust-Polui site, it is more likely that its long-term occupation was due to successful fishing activities supplemented by the hunting of sea animals at the mouth the Ob' River.

M.F. Kosarev takes much the same approach in his evaluation of the role of indigenuous maritime hunting in the northern part of Western Siberia. Citing P.S. Pallas and V.F. Zuev, Kosarev (1984:79–80) refers to the incidental nature of maritime hunting activities. With reference to the so-called followers of maritime hunting among individual Nenets families (mainly the Yaptick family) mentioned by Krupnik, it is evident that we are dealing with nomadism along the coast where maritime hunting was developing naturally.

It is clear that the dying out of maritime hunting was not due to any changes in ethnic tradition between the first and second millennia AD, for this activity played a definite role in the Samodic culture (and was significant for trade in the 10th to 13th centuries), as shown by ethnographic sources and the results of research. Krupnik is correct in attributing the end of sea hunting to unfavorable ecological change in the middle of the second millennium AD, and to the large-scale utilization of sea animals by the Scandinavian countries and Russia. And it is obvious that indigenous maritime hunting never resulted in the formation of settled cultures, similar to those of the Eskimos, for example.

Climatic changes in the eastern Arctic around the Pleistocene-Holocene boundary were rather important for indigeneous subsistence systems and the cultural evolution of the area.

As mentioned above (see Chapters 2 and 3), a regressive phase of the Arctic Ocean (100–120 meters deep), when the major part of the Arctic shelf zone was drained, is supposed to be the main factor affecting the natural development of this area. Thus rigorous climatic conditions of an arid, continental type appeared in the eastern Arctic. Extensive glaciation never existed in the area (Are 1982; Danilov 1989), although the permafrost was very well developed. The original open tundra-steppe landscape—populated by animals of the mammoth fauna assemblage—was the most distinct feature of the eastern Arctic natural environment up to the beginning of the Holocene (Verkulich et al. 1989; Makeyev et al. 1988; Tomirdiaro 1972).

The initial occupation of these periglacial landscapes evidently took place in the Terminal Pleistocene and can be supposed to be linked with migrations of mammoth hunters of the Dyuktai culture, whose sites are known at least to 71°N at the Berelekh site, located near the Berelekh "Mammoth Graveyard" (Vereschagin and Mochanov 1972; Mochanov 1977). However, the natural environment, which remained stable for a very long time, had changed owing to the global Late Dryas rise in temperature. The changes had the character of an ecological catastrophe since the climate became more humid, thus causing an increase in the thickness of the snow cover in winter and the development of lakes and swampy landscapes, which appeared to be critical for the animals of mammoth faunal assemblage and consequently to the subsistence strategy of indigenous cultures that were based on mammoth hunting. Therefore the terminal Pleistocene occupation of the eastern Arctic was characterized by a sharp crisis in the subsistence economy.

The major paleogeographic changes in the region during the Holocene were determined by trends in temperature and humidity, the development of thermokarsts, and oceanic transgression that gradually submerged and eroded the Great Pleistocene Arctic plain. Tundra-steppe landscapes were completely replaced by tundra formations (Giterman et al. 1968; Makeyev et al. 1988). At the same time, the Boreal shifting northward of forest vegetation (to somewhere near the position of the modern coastline and the southern Arctic islands) is believed to have been favorable for new migrations to the polar areas. The subsistence economy of the Mesolithic population that occupied Northeast Asia from 10,500 to 6000 BP was based on two major game species, namely, moose in the taiga zone and reindeer in the tundra. Faunal remains excavated from the Sumnagin sites, which have been discovered from the Taimyr to Chukotka, show that other animals such as bear and sheep (*Ovis canadensis*) also constituted part of the hunted prey. Fishing and bird hunting as supplements to the main activities also played a role in the indigenous subsistence economies (Egorov 1969; Mochanov 1977). The latter can be recognized as two main variants of continental adaptation that were standard in the taiga and tundra zones respectively. Due to the high mobility of the Mesolithic population, the region was completely occupied as early as 8000 BP when they reached Zhokhov Island (76°N)—the easternmost extremity of the New Siberian Peninsula, which existed during the Early Holocene (Degtyarenko et al. 1982). Though the hunting groups that visited the island represented a distinct continental type of adaption—evident from the analysis of the assemblage—the excavated faunal remains show a particular hunting specialization: polar bears and reindeer appear to have been taken in equal numbers (see detailed discussion above, Chapter III). This can be explained from the point of view of seasonality, but perhaps this unexpected specialization was determined by unstable reindeer hunting effected by the ecological crisis that took place near the Holocene boundary.

As shown by L.P. Khlobystin, the Taimyr region became occupied permanently due to environmental changes in the Early Holocene. Groups of Sumnagin reindeer hunters penetrated into the area about 7000 BP. Excavations of the most ancient site of Tagenar VI have revealed that the Taimyr natives survived through a general subsistence strategy that focused on reindeer hunting supplemented by fishing, gathering, and bird hunting. The Taimyr population appeared to be the most conservative in terms of a subsistence economy, which remained stable up to the most recent times. Thus the Taimyr is a unique archaeological region where the aboriginal culture can be traced back in great detail (Khlobystin 1982). The new populations that arrived several times, mainly from the Yakut area, were not influenced significantly by the subsistence strategy practiced in the Taimyr, although the cultural influence of the Neolithic Syalakh, Bel'kachi, and Ymyyakhtakh cultures are definitely among Taimyr archaeological materials. Yet the Samodic migratory wave, which took place much later and introduced to the indigenous population ideas of reindeer breeding, caused modifications in the local subsistence patterns.

In general, the Holocene climatic and environmental fluctuations that occurred in the Taimyr and Yakutiya were gradual in comparison with those of the European Northeast (Boyarskaya 1989), and affected the indigenous economies only slightly. It can be said that the region was occupied by mobile continental hunters who exploited reindeer populations in the tundra and moose in the taiga zone and supplemented this by hunting other animals, birds, and fishing, and gradually improving on these activities. Thus, primitive fishing based on using traps, supposedly known from Mesolithic times, was replaced by the more advanced net in the Late Neolithic. According to Fedoseyeva, the latter improved significantly the adaptation capabilities of Neolithic people, making their economy more flexible (Fedoseyeva 1980). Most likely that part of the population, including the Taimyr people (confirmed by folklore data collected by B.O. Dolgikh (1952), hunted sea animals while visiting the coastal tundra during seasonal migrations.

Northeast Asia takes a special place among the polar regions of the Eurasian continent due to its consistant Holocene environment. Tundra landscapes predominated in the region during the entire Holocene, and sparce forest vegetation was concentrated in river valleys even during the most favorable periods. Many others believe that the area adjacent to the Bering Land Bridge was initially occupied by Late Paleolithic mammoth hunters who later penetrated into the North American continent (West 1976; Dikov 1979:10–30; Mochanov 1977:223–241, etc). However, the area still lacks any real evidence of Paleolithic occupation (see Chapter IV). Much later, beginning in approximately 8000 BP, the region was the eastern part of the Mesolithic area—and later, Neolithic cultures that originated in the Yakutian cultural core. Some inland cultures, however, underwent a continental kind of adaptation. At the same time, the region is famous for the huge diversity of maritime resources representing the main ecological feature of the latter. Favorable ecology seems to be the most important aspect of the situation. In this connection the question of the origin of traditional maritime cultures, which existed in Northeast Asia approximately from the first century AD, has been discussed several times. Though there is no direct evidence of a genuine maritime adaptation going back to remote times, N.N. Dikov (1979:96–78, 161–165) has advanced the idea that the initial assimilation of maritime activities could have taken place as far back as Mesolithic times. In all probability this thesis is correct. However, a late formation of the maritime subsistence system is to be more realistic; the sea hunting could have been a supplemental element comprising a complex adaptation model of an early indigenous population that replaced the former focus with the latter. In general, we can find in this way definitions to help us recognize local variants in widespread cultural phenomena such as Sumnagin, Ymyyakhtakh, etc., even if they were mono-ethnic.

It is most likely that subsistence strategies of the indigenous groups populating the Chukotka region were based for a long time on general principles common to mobile reindeer hunters of the circumpolar zone: following the seasonal migrations of reindeer (Druri 1949; Syroyechkovsky 1986), spending part of summer in coastal lowlands. Evidently, initial assimilation of sea-hunting activities was connected with a forced temporal stay in the coastal tundra, where reindeer hunting was less productive due to dispersion of the reindeer herds. Though the waters surrounding the Chukchi Peninsula are extremely abundant in sea-mammal fauna (Ivashin et al. 1972:49), the formation of a maritime economy appeared to be a long-term process. The latter can be traced back by a few definite facts. There are petroglyphs known on the Pegtymel River that depict scenes of sea-animal hunting with the use of large boats. Dikov generally dates them to the first millennium BC. Sea-mammal hunting, known by artifacts from the Chertov Ovrag site on Wrangel Island, is much older—carbon dated to 3500 BP. Researchers suggest that implements found during excavation of the site are very similar to those of Independence Fjord in Greenland. However, numerous analogies in Chukotka are not too distant (Dikov 1979:157–159, 165–168; Tein 1979). Supposedly the island, located approximately 180 km north of the mainland, was discovered by hunting groups following migrating walruses that congregated in huge numbers at Cape Blossom (the southern extremity of Wrangel Island). At a distance of 15 km, the site is not far from a rookery. It is probable that the site was a summer hunting camp, confirmed in my mind by the nature of the faunal remains. The latter are represented exclusively by walrus and bird (duck) bones. The species of year-round habitation, such as seals (especially ringed seals) and polar bear, is represented by only two fragments (Tein 1979:54), though these animals are numerous on the island.

In all probability, Wrangel Island was visited by hunting groups from the Asian coast. Similarities between the Chertov Ovrag context and inland sites of the Chukchi Peninsula make it impossible to consider Chertov Ovrag site as evidence of a specialized maritime culture. The same can be said about the economic features of the Late Neolithic culture found in the Anadyr River valley, where a toggling harpoon head of archaic construction was excavated from a grave in the Ust-Belaya burial ground and dated to approximately 3000 BP (Dikov 1979). Concerning the Anadyr find, significantly effective walrus hunting was possible even in the most recent times at the Rudder Bank rookery, near the mouth of the Anadyr River. It is possible, too, that pieces of baleen discovered recently by M.A. Kiryak (1989) while excavating the Late Neolithic site of Rauchuagytgyn I in the western part of Chukotka (a distance of 120 km from the coast), indicate similar features of an indigenous subsistence economy. All of the data make it possible to assume that the population permanently inhabiting the inland tundra area was of a general continental hunting type. While a specific cultural type characterizing the groups that occupied the coastal tundra can be recognized as a modified continental adaptation, widely represented in the circumpolar zone and in the North Pacific (Vasilyevsky and Golubev 1976; Shumkin 1988; Fitzhugh 1973).

Late Neolithic sites in the eastern part of Chukotka have been identified by Dikov as the North Chukot and Ust-Belaya cultures, which he suggests are rather similar. At the same time, the contexts of both the former and the latter are similar (or familiar) to those of the Ymyyakhtakh culture. Owing to these observations, the major investigator of the Ymyyakhtakh relics, S.A. Fedoseyeva (1980), has concluded that formations defined as cultures in Chukotka can be considered provinces of the Late Neolithic Ymyyakhtakh cultural phenomenon. But Fedoseyeva does not define any local variants comprising the latter, though the Ymyyakhtakh sites were discovered in both the taiga and the tundra zones. To my mind, the sites represent a cultural unity only when being compared in the most general sense. Still they have distinct features that are helpful in forming cultural definitions. Thus A.P. Okladnikov (1970), who was a principal investigator of the Yakutian Neolithic, was for a long time of the opinion that there was a specific Late Neolithic Lower Lena culture. N.N. Dikov shares this view, comparing Chukchi Neolithic relics with those of the lower reaches of the Lena River. In my view, it is possible to identify at least the major local variants of the Ymyyakhtakh culture owing to the specific adaptation of the people who exploited different sources of taiga, forest tundra, and tundra zone respectively. It is significant, that precisely the sites located in the tundra and forest tundra were defined by Okladnikov as the Lower Lena culture. In this way, the difference between the late Neolithic of Chukotka and other Ymyyakhtakh sites can be explained by the specific character of the subsistence strategy, supplemented in Chukotka by seasonal maritime hunting (Pitul'ko 1988a, 1990).

Archaeological data, as mentioned above, show that the main components necessary for maritime hunting (such as specific hunting equipment and social organization of a high level) were acquired at least by the end of the second millennium BC. But the classic cultures of maritime adaptation, based on specific principles, appeared much later, about 2000 BP. Keeping in mind the flexibility of both the subsistence economies and the material cultures of the indigeneous Arctic population (Arutyunov 1982; Fainberg 1971), it is impossible to assume that the formation of maritime adaptations took 1,500 years. Most likely, the major factor that caused the appearence of maritime adaptations can be found as the long-term effect of the regional climatic trend that occurred during Sub-Boreal and Sub-Atlantic periods—unfavorable for the survival of reindeer, the main game species. We can find indirect confirmation of this assumption by referring to Krupnik's analysis of environmental fluctuations in the present millennium. It was revealed that even small-range changes caused a critical decrease in reindeer populations due to such things as epizootics, decrease in fodder, etc. (Krupnik 1989:119–132).

Further cultural evolution of Northeast Asia was determined by the co-existence (and forced co-operation, as shown by Krupnik) of mobile continental hunters, who occupied inland areas, and settled maritime cultures exploiting resources in coastal ecological niches. Some stages of the latter are definitely recognized through sharp differences in hunting specializations:

1. Old Bering Sea (or Old Bering Sea–Okvik)—approximately from 2200 to 1500 BP; walrus hunting is of great importance;
2. Birnirk—mid-firstt millennium AD; sealing and reindeer hunting play the most important role;
3. Punuk—the second half of the first millennium AD to the first centuries of the present millennium; whaling (Balaena mysticetus) is most important;
4. Thule—the middle of the present millennium; sealing became more important, though whaling also played a role.

As shown by Krupnik (1989:165–174), the succession of changes in the subsistence strategies in Northeast Asia has a precise correlation with the detailed climatic stratigraphy covering the last millennium.

In summary, one can note that in both western and eastern Polar Regions of Eurasia, the formation of cultures with maritime subsistence systems took place. At the same time, there is an obvious difference between the areas mentioned: thus, if the maritime cultures of Northeast Asia appear to be relatively young—traced back to 3500 or 4000 BP—those of the Far European North have a history going back to more remote times. It seems to be probable, too, that a favorable ecology or abundance of marine resources did not ensure success in the formation of maritime adaptations, as with the indigenous maritime culture in the Polar Trans-Ural zone. The early assimilation of maritime subsistence activities in Northern Fennoscandia was evidently caused by peculiarities in the initial occupation of the area during the terminal glaciation, when pioneer migrants were forced to move along the narrow coastal strip—an ice-free corridor—between glacial margins and the shore line. In my view, this is a good illustration of the thesis that Arctic people became maritime hunters only when forced to.

The rest of the Polar zone of Eurasia was populated by reindeer hunters, whose subsistence systems were different in few details, representing in general a simple way of life. Some kinds of supplemental activities could have been more or less important. Thus it is supposed that semi- (seasonally) settled groups appeared during the Neolithic in regions characterized by high productivity in fishing. As suggested by Yu. B. Simchenko (1976), the most common feature of tundra-forest tundra subsistence strategies, practiced by reindeer hunters of the Polar Region for a very long time, at least from the beginning of the Holocene, was the seasonal-migration type within the limits of some definite area. It is most likely that some groups created a network of temporal or long-term camps, solving in this way such problems as transportation, housing etc. Systems of this kind are known both from ethnography and archaeology, at least for the Taimyr region (Khlobystin 1972). Undoubtedly, this strongly improved the adaptation capabilities of the indigenous population. Various hunting methods were in use, both of an individual and a collective character. Diverse methods of individual and group hunting at river crossings, especially characteristic in East Siberia—described in detail by travellers of 18$^{th}$ and 19$^{th}$ centuries—were extremely popular (Syroyechkovsky 1986:170–204). Further evolution of the general subsistence strategy that formed in the tundra zone of Eurasia resulted in the appearence of more stable, complex subsistence systems of "late hunters" (Krupnik 1989:148), who used reindeer for transportation and acquired ideas of reindeer breeding.

In that way, the cultural development of the Arctic region as well as the major stages of its occupation was strongly affected by environmental changes from the very beginning. Supposedly, as shown above, the starting point of human occupation in the Arctic is dated to some period in the Late Pleistocene. But…

# SUMMARY AND CONCLUDING REMARKS

Ancient man, his environment, culture, and adaptation strategies—all these research directions have been traditional for Stone Age archaeology for a long time. They are especially important for the archaeology of the Arctic regions. It can be said that the history of human occupation of the Arctic from the very beginning has been strongly influenced by the peculiarities of the local Pleistocene and Holocene environments.

The most important goal of this book is to present the data obtained from the unique Mesolithic site on Zhokhov Island and show its significance for the archaeology of the Arctic. This is the oldest site known in the high Arctic regions. These lands are sparsely populated even now while the site gives evidence of human habitation as far back as 8,000 years ago. This case of Arctic prehistory gave rise to new and interesting questions that cannot be answered without discussing a number of broader problems such as the development of the Late Quaternary environment in the Arctic, the timing of initial human migrations into arctic regions, and the historical dynamics of human adaptations in Arctic environments.

At the same time, it is important to give an overview of the history of archaeological work in the Russian Arctic. This work has an unexpectedly long history that started more than 200 years ago when Captain Sarychev began excavations at an Eskimo site some forty kilometers east of the Kolyma River estuary, near Cape Bolshoy Baranov. This happened on the 22$^{nd}$ of July, 1787, and became the day when Arctic archaeology was born. Moreover, this is also the birth date of Russian field archaeology as a whole.

Interestingly, the site was revisited and investigated by A.P. Okladnikov in the middle of the 20$^{th}$ century. This tells about the stability of the coast line for almost 200 years, which is quite unexpected since coastal dynamics in the Arctic regions are thought to be very high. Thus, in the New Siberian Islands, on banks where permafrost is exposed, it easily amounts to dozens of meters per year.

The history of Arctic archaeology in Russia, reviewed in the first chapter of this book, clearly falls into three major periods. The first is characterized by occasional collecting of archaeological materials by travelers, amateur archaeologists, etc., and by very rare archaeological field research projects. This period lasted for more than 100 years and ended roughly with the beginning of World War I (A.I. Schtukenberg, A.V. Zhuravsky, N.A. Kulik, N.I. Popov, A. Argentov). It is worthy of note that many fundamental ideas, which became the basis for archaeological and paleoenvironmental research in the Siberian Arctic, were put forward as early as this time (I.D. Chersky, W.I. Jochelson, A.Y. Tugarinov, V.K. Arsenyev, M.M. Yermolaev). It must be stressed that the most prominent ideas in the geology, paleogeography, and archaeology of Arctic Siberia advanced at the beginning of the 20$^{th}$ century were based primarily on results produced by the expeditions of Baron Edward Toll, one of the most famous Russian Arctic researchers.

The second period is much shorter, covering the 1920s–1950s. In fact, this is an extension of the first period, especially in the style of research activities: sporadic research projects, occasional collecting, with the most important role being played by metropolitan professionals primarily from St. Petersburg (Leningrad). These projects brought important results which determined basic ideas and directions for future work in the Russian Arctic (B.F. Zemlyakov, M.E. Foss, N.N. Gurina, V.N. Chernetsov, A.P. Okladnikov).

The third period, the onset of which is connected with the appearance of regional research centers, is characterized by long-term research projects carried out in many Arctic regions such as the Kola Peninsula, the Taimyr, Sakha Republic, and the Chukchee Peninsula. These favorable changes in the development of Arctic archaeology took place in the 1970s-1980s but were terminated by the collapse of the Soviet/Russian economy in the 1990s. For the past twenty years no systematic research in the Russian Arctic has been done, with the exception of certain areas. However, even in times of the successful development of Arctic archaeology less has been accomplished than could have been because of poor coordination, unclear research priorities, and insufficient funding. All these problems have recently been complicated by negative tendencies in the economy and still exist.

If during the first two periods the archaeological studies of the Arctic were primarily associated with the activities of St. Petersburg (Leningrad) scientists and to a lesser extent their colleagues from Moscow, the third period is related mainly with the formation of regional research groups in Arkhangelsk, Syktyvkar, Yakutsk, and Magadan. But still, long-term projects were carried out on the Kola Peninsula (N.N. Gurina, V.Y. Shumkin), the Taimyr, and in the far northeastern part of European Russia (L.P. Khlobystin). Because of a large amount of non-archaeological research activity in the1960s and 1970s, a plethora of non-professional collections were delivered from different regions. Collecting of a more or less systematic character was done by geologist G.A. Chernov in the northeastern part of European Russia. In Yamal and adjacent areas several important research projects were done by A.V. Golovnev, N.V. Fedorova, and W.W. Fitzhugh. In Arctic Siberia a series of field projects conducted by N.N. Dikov, Y.A. Mochanov, and S.A. Fedoseeva, then by M.M. Bronstein and K.A. Dneprovsky, S.V. Gusev, S.B. Slobodin, and V.V. Pitulko should be also mentioned.

But clearly all activities in field archaeological research in the Russian Arctic began to decrease in 1991 because of the collapse of the Soviet Union and economic problems. In addition, a number of leading scientists passed away (N. N. Dikov, N. N. Gurina, L. P. Khlobystin) at the end of the 1980s and the early 1990s.

It can be concluded that during the time of fruitful research activity in the Russian Arctic (chiefly in the 1960s through the 1980s) almost all areas were preliminarily studied. That provided a sort of pilot knowledge for most of the regions of the Russian Arctic. However, many of them remain studied only in minimal degree. Thus, North European Russia, including the Kola Peninsula, have the longest history of research, while most of Arctic Siberia—Yamal, the northern areas of Western Siberia, the Taimyr Peninsula, and Northeast Siberia (except for Chukotka to a certain degree), in which archaeological research began in 1960s and 1970s—still remains poorly studied.

Most of the islands within the Russian Arctic remained unexplored even at the end of the 20th century. Some of them were surveyed in the mid-1970s (the discovery of the Devil's Gorge site on Wrangel Island by N.N. Dikov) and in the second half of the 1980s when Stone Age sites were discovered in Vaigach Island (V.V. Pitulko and G.I. Ivanov) on the boundary of Barents and Kara Seas, and then on Zhokhov Island in the New Siberian Islands (V.V. Pitulko). These data provide a background for a new approach to the questions of human migrations into the High Arctic and cultural evolution in Arctic regions, as well as trace back the history of human adaptations in the Arctic.

To my knowledge, about 1,300 archaeological sites were known in the Russian Arctic in the early 1990s. That includes archaeological materials of past 10,000 years, and logically, most of them belong to the more recent times. It should be also stressed that the different areas of the Russian Arctic have been studied very unevenly. Blank spots alternate with studied areas. Some territories, such as the Kola Peninsula and to some extent the Taimyr, are well studied, while others, such as the far Northwest Siberia, either have never been surveyed or have yielded very poor and fragmentary data. Northeast Asia and the northern portion of European Russia have very specific taphonomic conditions determined by local geological processes and the nature of the matrix sediments. Thus, many sites have been redeposited; there are many mixed assemblages or non-diagnostic contexts. And even if it can be said that there has been great progress in Arctic archaeology in Russia, compared to the first half of the 20th century, the archaeology of the Stone Age in the Arctic has still not advanced far beyond the starting point.

However, the information acquired during these explorations was enough to raise the most important research questions, such as the time of initial human migrations to the Arctic regions of Eurasia, their connection with environmental changes, cultural evolution in the Arctic, and the history of human adaptations in the Arctic. There is no doubt that paleoenvironmental changes played the most important role in these processes.

An overview of the Late Pleistocene and Holocene environmental dynamics in the Arctic is presented in Chapter II from the point of view of the problem of initial human occupation of this region. Special attention is given to the period of the last glaciation in the Late Pleistocene. It is generally recognized that land glaciation is extremely interesting, and not just as a natural phenomenon itself, affecting climatic and environmental changes in the enormous territories of both hemispheres, the evolution of flora and fauna, and a cause of global ecological changes, but as important factor, or even one of the most important, affecting human culture, migrations, and peopling of the globe.

Availability of certain areas of the Arctic for occupation by the early people is a key limiting factor that makes a difference in the timing of the first migrations into the Arctic regions. There are two zones with very different features of environmental evolution and, respectively, different possibilities for humans to explore and populate them. Although many details still remain to be clarified, these questions are more or less solved for Scandinavia/the Kola Peninsula. It is supposed that the area became populated as early as 11,000–10,000 years ago, starting from the coastal regions as soon as they became deglaciated. For the rest of the Russian Arctic the situation is less clear since in many cases information on the earliest human habitation in the area is too unreliable to draw firm conclusions. Thus, the far north of European Russia was probably populated earlier than 6,000 years ago, but there is no clear archaeological evidence of this. The earliest sites are dated to 6000 BP. The problem of the earliest colonization of this area by humans is clearly linked with questions of the last glaciation, i.e., how long the glaciation lasted and how quickly the territory was deglaciated. Data on environmental changes near the Pleistocene/Holocene boundary in the north of Western Siberia and the Taimyr Peninsula show that these territories were most likely populated as early as 10,000 years ago, although there is no direct archaeological evidence of this. The earliest dated sites for these territories are $^{14}C$ dated to ~8000 BP (the Korchagi site on the Lower Ob River) and ~6000 BP in the Taimyr.

But if the peopling of the European Far North and the northern areas of Western Siberia and the Taimyr Peninsula were affected primarily by regional glacial trends, these processes were of a different character in the East Siberian Arctic. The significant sea-level drop during the LGM exposed extensive portions of the shelves along the Arctic Siberian margin. At that time the Great Arctic Plain expanded from the Taimyr Peninsula to the Bering Strait area and up to 76°N including the New Siberian Islands and Wrangel Island. These lowlands, as well as the neighboring area of the Bering Land Bridge, became eroded and/or submerged by the pre-Holocene transgression of the Arctic Ocean. However before that it was a giant ecological niche providing unlimited food sources for potential human inhabitants. Clearly it was populated permanently or visited regularly in its eastern part adjacent to Bering Land Bridge some time before the New World became inaccessible by land. However, archaeological research carried out in that region both in Alaska and on the Chukchee Peninsula failed to find any indisputable materials that could be dated earlier than 11,000 BP. But it is also possible that this material does not exist there, and that the migrants, whoever they were, moved along the south shore of the Bering Land Bridge.

Although a single site, the Berelekh site, in fact documents Late Pleistocene human habitation in Arctic Siberia; there is no doubt that it all was populated at this time. The Berelekh site, discovered by N.K. Vereschagin and then excavated by Y.A. Mochanov in the early 1970s, was radiocarbon initially dated at 13,000–12,000 BP (additional dating shows that it might probably be some younger—about 11,000–10,000 BP). This northernmost terminal-Pleistocene site marks the northern boundary of known Paleolithic occupation and shows that the continental Arctic was populated at least up to 71°N at this time. The Zhokhov site, which is some 3,000 years younger than Berelekh, has hidden potential for expanding the limits of human habitation in the Arctic at the beginning of the Holocene, or it may simply show the unknown limits of potentially possible survival and/or adaptation skills of early Arctic people.

Human dispersal in the Arctic, and not just in the Asian part, evidently became much extensive in the Early Holocene. Archaeological materials that tell about human culture of this time are rather scanty. But still there are thirty to forty sites in the region from the Taimyr to the Chukchee Peninsula. Not many of them are radiocarbon dated or have clear geology, but it can be concluded that microblade/Mesolithic technologies spread within the area no later than 8,000 years ago (in the Taimyr, however, the oldest dated site is Tagenar VI, dated to 6000 BP). It is remarkable that the spread of the microblade technologies that took place in Siberia at around the Pleistocene/Holocene boundary was very fast. The Ust-Timpton and Sumnagin sites, located far south in Siberia on the Aldan River, are almost of the same age as the Tagenar VI site. It could probably be explained by the increased mobility of hunting groups that were forced to change their hunting specialization or subsistence strategies.

The Mesolithic site excavated in 1989 and 1990 on Zhokhov Island in the De Long Archipelago at 76°N belongs exactly to this period. Its age and material culture document the early and fast spread of prismatic microblade technologies with Northeast Asia. The New Siberian Islands and adjacent mainland clearly have a great potential for finding sites similar to the Zhokhov settlement. These areas are important because they contain relicts of the extinct Late-Pleistocene Arctic Plain, which was the westernmost part of Pleistocene Arctic Beringia, and thus may preserve part of the archaeological record important for problems of peopling of the New World.

Archaeological data on the initial population of the Arctic show that, in general, the peopling of Arctic territories was rather rapid. For many of the regions the time of actual initial migration cannot be determined, at least for now—with the exception of areas that were populated after deglaciation, such as Scandinavia, the Canadian Arctic, or the Kola Peninsula. The density of the population always remained minimal. Most likely the Arctic territories became occupied as soon they as they were available, but the earliest archaeological stages are poorly visible. Consequently, for Arctic Siberia the time of initial migration is limited only by the presence of anatomically modern humans in the Late Pleistocene. From the Zhokhov site it is clear that they were able to move north as far as 76°N at about 8,000 years ago. Another good example can be found in the Canadian Arctic and Greenland where paleo-Eskimo sites appeared about 4,500–4,000 years ago, immediately after deglaciation of the shorelands and the islands. Finds by Eigel Knuth in Peary Land at 82°N show that the tendency to occupy all available territories had occurred that time.

Important is the fact that Early Holocene assemblages from northern Central and Eastern Siberia are very similar. This uniform cultural character served as a basis for suggesting that they were components of a large cultural phenomenon that extended from the Taimyr to the Chukchee Peninsula, with a cultural influence that reached even to Alaska. This phenomenon, known as the Sumnagin culture, is the first in a sequence of Holocene Stone Age cultures covering this area (all are Neolithic except Sumnagin, which was first discovered in the southern Sakha Republic; I call it the "Yakutian Cultural Core").

The Mesolithic Zhokhov site is fully described in Chapters III and IV. Because of the excellent degree of preservation of organics, it yielded a number of wooden, bone, antler, and mammoth ivory artifacts that show the well-developed character of the Early Holocene human culture in Arctic Siberia, as well as its high technological level. In general, this is an almost "ethnographic" degree of preservation of 8,000-year-old archaeological material that shows how it might have looked. All this richness is usually long gone through taphonomic processes before the archaeologist can touch it. Thus, in the Zhokhov case, without the permafrost conditions, the collection would include few hundred microblades and flakes and a couple dozens microblade cores.

Due to the general features of the collection and the radiocarbon dating, a general background for the Zhokhov Island site can be easily found: it has to be placed within the Mesolithic relics of Northeast Asia that make up the Sumnagin cultural phenomenon, or the Sumnagin culture of the Holocene Paleolithic, according to Y.A. Mochanov. The previous (Late Pleistocene) stage of human occupation of Northeast Asia is considered by Mochanov to be connected with the spread and development of the Paleolithic Dyuktai culture. However sites of the Dyuktai culture are poorly represented in the area. Also, there is no evidence for a cultural connection between the Sumnagin culture and the preceding one, since the Sumnagin culture is a prismatic microblade industry with no bifaces, while the Dyuktai culture is based on wedge-shaped core technology with bifacial projectiles, "knives," and "spear points." The reason for this major cultural change at about Pleistocene/Holocene boundary is still under discussion, but, whatever it was, the uniform appearance of Mesolithic finds across Northeast Asia is fully accepted.

This "uniformity" (which allowed a uniform conclusion about the past existence of a Sumnagin cultural tradition covering almost all of Arctic and Subarctic Siberia) is most probably the result of a poor level of investigation in the area where there are few stratified radiocarbon-dated sites. Accordingly, these materials in most cases do not allow recognizing local and/or chronological cultural traditions. It has to be stressed that in most cases these are just lithic collections. As the number of well-studied sites increases, such "uniformity" becomes broken.

Thus, Slobodin (1999) was able to recognize the Uolba facies of the Sumnagin cultural tradition, which biogeographically corresponds to the taiga zone. Projectile points made on large blades were used as a new "type fossil". The Zhokhov site does not have such remarkable tools in the stone inventory, which makes it very simple—there are microblades and cores for producing them, and ground tools that have no known analogy in radiocarbon-dated synchronous sites within Northeast Asia. However, the microblade knapping technology reconstructed from the Zhokhov industry makes it possible to speak of the Arctic facies of the Sumnagin cultural tradition that probably was characteristic for the coastal lowlands of Northeast Asia and which extended into Chukotka and Alaska, and further south into North America and British Columbia (Pitulko 2001). However, how many cultural similarities can be discussed as "connections" still remains unclear.

One of the most important artifacts found at Zhokhov is a large fragment of sled runner. Together with some of the wooden artifacts that come from the site that are possibly uprights for sled construction and domestic dog bones, the sled runner serves as evidence that developed dog traction technology was known to the early Holocene hunters of Arctic Siberia. This is the earliest evidence for that. This also indicates that the idea of using dogs with sleds and the technology for doing this had to have been shaped long before humans arrived on Zhokhov Island and camped there. The ability to use dog teams probably served as a key to mobility for Arctic hunters and was an important feature of their culture and adaptation strategy.

Two major adaptation strategies are archaeologically known in Northern Eurasia (an overview of archaeological evidence for them is given in Chapter V). The western and the eastern portions of the region were the area of origin and existence of maritime adaptations. However, if they are relatively young in Northeast Asia, they are much older in the European North, although natural conditions for that were even better in Northeast Asia than in the European North. The early involvement of the population in the exploitation of marine resources in Northern Scandinavia was supposedly determined by the peopling of the area through an ice-free coastal corridor between the glacier and the shoreline. The littoral of these areas was very rich in marine food sources, but also limited in terrestrial ones. The Chukchee Peninsula in the Bering Strait area (well known for maritime adaptation strategies practiced by local populations for approximately the past 3,000 years) was originally inhabited from the inland areas by terrestrial hunters. They started exploiting marine resources after being forced to do so by the modern geography, which was finally formed in the middle of the Holocene.

It can be said that Northern Scandinavia and the Kola Peninsula had a "deglaciation driven" area available for human population (expansion of the area), while Northeast Asia had an "oceanic-transgression driven" area (decrease of the area which was quite extensive initially and probably with relatively low population pressure). The Zhokhov Island site illustrates this well – the Zhokhov hunters lived on the margins of the Early Holocene Arctic population area, directly on the coast; they used driftwood for artifacts and for firewood but did not hunt sea mammals and did not use marine food sources in any form. They hunted reindeer and polar bears, but even the polar bear hunt was based on principals common for terrestrial hunters elsewhere.

It is well known that most of the Eurasian North was historically occupied by cultures with a subsistence economy based on reindeer. The remarkable feature of these cultures is high mobility and, most likely, flexible subsistence patterns. High productivity in fishing creates the basis for the appearance of semi-sedentism in areas especially rich in this resource. Simchenko wrote that the most characteristic feature of these cultures is so-called pendulum migrations, i.e., seasonal migrations in a more or less permanent area when the length, duration, and direction of the route depend on the reindeer.

It is most likely that the ancient inhabitants of the Arctic created arrangements of temporary (seasonal) camps within the bounds of the main hunting area. Khlobystin suggested that such systems were practiced in the Taimyr from 3,000 years ago or even earlier. Their use extended the adaptation capabilities of hunting groups. The groups used diverse strategies, both individual and collective. Perhaps the Zhokhov site was one such temporary/seasonal camp that was needed to control the territory, on one hand, and to exploit a particular food resource at the same time, or to accumulate resources for temporary storage. This strategy requires certain mobility that could be provided by the dog traction known from the Zhokhov site.

The Zhokhov materials are both an easy subject to discuss and a difficult one. Because of their early Holocene age and unique geographical position in northern Northeast Asia and the excellent preservation of different organics, which are usually absent in contemporaneous sites, the Zhokhov assemblage is undoubtedly one of the finest archaeological sites of the Stone Age in Northern Asia. It can be said that the Zhokhov materials of 7,800 years ago lack similarity with contemporaneous archaeological assemblages of Northeast Asia. However, there are numerous artifacts whose presence makes it possible to find broad analogies that are more illustrative of general tendencies in Late Pleistocene/Early Holocene cultural development (e.g., development of inset tool technology), rather than just a few features of similarity or familiarity of the Zhokhov assemblage with neighboring sites and cultures. In my view, the Zhokhov site is even more important because the information "contained" in it exceeds the regional level of meaning. It is a real and important contribution to the general knowledge of human history.

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Expeditions to Zhokhov Island done in 1989 and 1990 became the most unusual experience of my life. To be honest, I did not expect to find too much of the archaeological material and thought of what to do if the site does not produce enough of it to be busy the whole summer. Than bigger was the surprise …

Nothing would happen if Vyacheslav Makeyev did not find the man who found the first artifacts and tell then the story to Sergey Kessel who contacted Leonid Khlobystin, my Professor and chief of the expedtions to Russian European Arctic and Vaigach Island which gave me lots of experience. Khlobystin suggested to me to go there if there is a chance. The chance came up soon when Makeyev invited me for the expedition in 1989. That was about a year after Khlobystin died.

I will be always thankful to all of them for their attention to my work and support in different forms given to it as well as to my co-travelers in Zhokhov Island—Vyacheslav Makeyev, Sergey Zementov, Mikhail Samarsky, and Mikhail Anisimov without whose help the first excavations of Zhokhov site would be less successful. Enormous thanks to Richard Bland and Roy Carlson whose patience, help, and advice significantly improved the original English version of the book.

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# REFERENCES


**Abramova, Z. A.**

**1967** O vkladyshevykh orudiyakh v paleolite Yeniseya [About Compound Tools of the Paleolithic Culture in the Yenisei River Area]. *KSIA* 111:12–18.

**1979a** K voprosy o vozraste Aldanskogo paleolita [On the Question of the Dating of the Aldan River Paleolithic]. *SA* 4:5–14.

**1979b** *Paleolit Yeniseya. Afontovskaya kul'tura* [The Paleolithic of the Yenisei River Area. The Afontovo Culture]. Nauka, Novosibirsk.

**1979c** *Paleolit Yeniseya. Kokorevskaya kul'tura* [The Paleolithic of the Yenisei River Area. The Kokorevo Culture]. Nauka, Novosibirsk.

**Aksenov, M. P.**

**1980** Mnogosloiny arkheologichesky pamyatnik Makarovo II [The Stratified Site of Makarovo II]. *DINYuVS* 1:91–113.

**Aleksandrova, V. D.**

**1977** Geobotanicheskoye raionirovaniye Arktiki i Antarktiki [Identification of Geobotanic Regions in the Arctic and Antarctic] *Komarovskiye chteniya* XXIX:5–45.

**Andersen, B. G.**

**1965** The Quaternary of Norway. In *The Geological Systems,* Rankama K. (Ed.)., pp. 91–138.The Quaternary Interscience Publishers, New York.

**Anderson, D. D.**

**1970** Akmak: An Early Archaeological Assemblage from Onion Portage, Northwest Alaska. *Acta Arctica* 16. Copenhagen.

**Anpilogov, A. V.**

**1969** Otchet o polevoi rabote v 1969 g. Arkhiv IA RAN, r-1, N 3905 [Field report of 1969. Archive of the Institute for Archaeology]. Moscow.

**Antevs, E.**

**1935** The Spread of Aboriginal Man to North America. *The Geographical Review* 25(2).

**Are, F. E.**

**1982** Ob otnositel'nom urovne morei Laptevykh i Vostochno-Sibirskogo v poslelednikov'ye [The Relative Postglacial Sea-Level of the Laptev and East Siberian Seas]. In *Kolebaniya urovnya morei i okeanov za 15.000 let* [Sea and Ocean Level Fluctuations for 15,000 years], pp. 168–174. Nauka, Moscow.

**Argentov, A.**

**1879** Nizhne-Kolymsky krai [The Lower Kolyma Region]. *IRGO* XV(6).

**Argunov, V. G.**

**1989** *Kamenny vek Severo-Zapadnoi Yakutii* [The Stone Age of Northwestern Yakutia]. Avtoreferat kand. diss., Yakutsk.

**1990** *Kamenny vek Severo-Zapadnoi Yakutii* [The Stone Age of Northwestern Yakutia]. Nauka, Novosibirsk.

**Arkhipov, N.**

**1989** *Drevniye kultury Yakutii* [Ancient Cultures of Yakutia]. Yakutsk.

**Armand, A. D., and N. N. Armand**

**1965** Kraevye zony valdaiskogo oledeneniya na Kol'skom poluostrove [Marginal Zones of the Valdai Glaciation on the Kola Peninsula]. In *Posledny Evropeisky lednikovy pokrov,* pp. 44–59. Nauka, Moscow.

**Armand, A. D., N. N. Armand, and A. A. Nikonov**

**1963** Osobennosti istorii poslednego oledeneniya na Severo-Vostoke Fennoskandii [Features of the Last Glaciation in Northeastern Fennoscandia]. *Izvestiya AN SSSR* 2:55–60.

**Arsen'yev, V. K.**

**1948** Lednikovy period i pervobytnoye naseleniye Vostochnoi Sibiri [The Ice Age and Early Man in Eastern Siberia]. In *Sochineniya,* Tom V, pp. 111–136. Vladivostok.

**Arslanov, Kh. A., A. S. Lavrov, and L. D. Nikiforova**

**1981** O stratigrafii, geokhronologii i izmeneniyakh klimata srednego i pozdnego pleistocena na Severo-Vostoke Russkoi Ravniny [Notes on the Stratigraphy, Geochronology, and Climatic Changes of the Late

Pleistocene in the NE Area of the Russian Plain]. In *Pleistotsenovye oledeneniya Vostochno-Evropeiskoi ravniny,* pp. 12–27. Nauka, Moscow.

**Arslanov, Kh. A., V. V. Lyadov, B. A. Filonov, and S. B. Chernov**

**1982** Ob absolyutnom vozraste Yuribeiskogo mamonta [On the Absolute Dating of the Yuribei Mammoth]. In *Yuribeisky mamont,* pp. 35–37. Nauka, Moscow.

**Arslanov, Kh. A., A. S. Lavrov, and L. M. Potapenko**

**1983** Novye dannye o pozdnepleistotsenovom oledenenii Zapadnoi Sibiri [New Data on the Late Pleistocene Glaciation in Western Siberia]. In *Oledeneniya i paleoklimaty Sibiri v pleistocene,* pp. 27–36. Nauka, Novosibirsk.

**Arutyunov, S. A.**

**1982** Problemy primorskoi adaptatsii v Beringomorskom regione [Problems of Maritime Adaptation in the Bering Sea Region]. In *Paleometall Severo-Zapadnoi chasti Tikhogo okeana,* pp. 78–97. Vladivostok.

**Arutyunov, S. A., and D. A. Sergeyev**

**1969** *Drevniye kultury aziatskikh eskimosov (Uelensky mogil'nik)* [Ancient Cultures of the Asiatic Eskimos. The Uelen Burial Ground.]. Nauka, Moscow. [In translation: *Ancient Cultures of the Asiatic Eskimos: The Uelen Cemetery*. Beringian Shared Heritage Program, National Park Service, Anchorage, Alaska. 2006.]

**Astakhov, V. N.**

**1980** Struktura severnogo pleistotsena po dannym kosmicheskikh i vysotnykh syomok [Northern Pleistocene Topographic Composition According to the Data of Remote Control Systems]. *Earth Studies from Cosmos* 5:22–25.

**1982** O proiskhozdenii i paleogeograficheskom znachenii holmisto-gradovogo rel'efa Zapadnoi Sibiri [Origin and Significance of the Hilly-Ridged Topography of Western Siberia]. In *Razvitiye prirody territorii SSSR v pozdnem pleistocene i golotsene,* pp. 16–22. Nauka, Moscow.

**Astakhov, V. N., and L. L. Isayeva**

**1985** O radiouglerodnom vozraste poslednego oledeneniya v nizov'yakh Yeniseya [The Absolute Age of the Last Glacial in the Lower Yenisei Area]. *DAN SSSR* 283(2):438–440.

**Auerbakh, N. K., and G. P. Sosnovsky**

**1932** Materialy k izucheniyu paleoliticheskoi industrii i uslovy ee nakhozhdeniya na stoyanke Afontova Gora [Materials for Studies on the Paleolithic Industry and Geology of the Afontova Gora Site]. *TKIChP* 1:45–113.

**Avdalovich, S. A., and R. A. Bidzhiyev**

**1984** Karginskiye morskiye terrasy na Severe Zapadnoi Sibiri i problemy Sartanskogo oledeneniya [Karga Marine Terraces in the West Siberian North and Problems of the Sartan Glaciation] *Izvestiya AN SSSR*, Geographic series 1:10–33.

**Avenarius, I. G., and M. V. Muratova**

**1978** Klimaticheskiya usloviya i nekotorye cherty landshaftov Severnoi Evrazii v epokhu golotsenovogo klimaticheskogo optimuma [Climatic Conditions and Landscapes in Northern Eurasia during the Holocene Climatic Optimum]. In *Paleogeographiya Severnoi Evrazii v pozdnem pleistocene-golocene i geografichesky prognoz,* pp. 42–53. Nauka, Moscow.

**Bader, O. N.**

**1966** Mezolit lesnogo Priural'ya i nekotorye obschiye voprosy izucheniya mezolita [The Mesolithic of the Forested Ural Area and Some General Questions on Mesolithic Studies]. *MIA* 126:194–205.

**Badinova, V. P., V. A. Zubakov, and Ye. M. Itsykson (et al.)**

**1976** Radiouglerodnye datirovki laboratorii VSEGEI (LG). Spisok III [Carbon-14 Dates of the VSEGEI Radiocarbon Laboratory, LG index, List III]. *BKIChP* 45:154–157.

**Berg, G.**

**1934** Sledges and Wheeled Vehicles. *Nordiska Museets Handlingar* 4.

**Bespaly, V. G., and O. Yu. Glushkova**

**1987** Severo-Vostok [The Northeast Region]. In *Chetvertichnoye oledeneniye territorii SSSR,* pp. 62–70. Nauka, Moscow.

**Binford, L. R.**

**1981** *Bones: Ancient Men and Modern Myths*. Academic Press, New York.

**1983** *In Pursuit of the Past.* Thames and Hudson, London.

**Binford, L. R., and J. B. Bertram**
**1977** Bone Frequencies—and Attritional Process. In *For Theory Building in Archaeology,* pp. 77–153. Academic Press, New York.
**Blake, W.**
**1970** Studies of Glacial History of Arctic Canada. Pumice, Radiocarbon Dates and Differential Postglacial Uplift in the Eastern Queen Elizabeth Islands. *Canadian Jornal of Earth Sciences* 7:634–664.
**Blazhchishin, A. I., and D. D. Kvasov**
**1980** Paleomagnitnye datirovki Barentseva lednikovogo schita i ikh znacheniye dlya teorii oledeneniya [Paleomagnetic Dating of the Barents Ice Sheet and Its Significance for the Glaciation Theory]. In *Geokhronologiya chetvertichnogo perioda,* pp. 34–40. Nauka, Moscow.
**Boas, F.**
**1929** Migrations of the Asiatic Race and Cultures to North America. *Regr. from the Scientific Monthly* 28.
**Bogoras, W. G.**
**1929** Elements of the Culture of the Circumpolar Zone. *American Anthropologist* 31(4).
**Boikova, I. M., Yu. N. Gribchenko, and V. P. Nechaeyev**
**1982** Relief i chetvertichnye otlozheniya Zapadnogo Yamala [Relief and Quaternary Deposits of the Western Yamal]. In *Razvitiye prirody territorii SSSR v pozdnem pleistotsene i golotsene,* pp. 22–27. Nauka, Moscow.
**Bokony, S.**
**1970** A New Method for the Determination of the Number of Individuals in Animal Bone Material. *American Journal of Archaeology* 74:291–292.
**Bonnichsen, R.**
**1979** Pleistocene Bone Technology in the Beringian Refugium. *Archaeological Survey of Canada* 89.
**Boyarskaya, T. D.**
**1989** Sopostavleniye amplitudy izmenchivosti paleoklimatov pozdnego pleistotsena i golotsena razlichnykh raionov SSSR [Correlation of the Late Pleistocene–Holocene Climatic Trends of the Different Territories of the USSR]. In *Paleoklimaty pozdnelednikovya i golotsena,* pp. 85–90. Nauka, Moscow.
**Boyarskaya, T. D., S. V. Kiselev, and S. A. Kuz'mina**
**1989** Osobennosti klimata Zapadnoi Chukotki v pozdnem pleistotsene i golotsene [Climatic Features of Western Chukotka in the Late Pleistocene and Holocene]. In *Paleoklimaty pozdnelednikovya i golotsena,* pp. 151–154. Nauka, Moscow.
**Broadbent, N.**
**1979** Coastal Resources and Settlement Stability. *Archaeological Studies*. Uppsala University, Institute of North Archaeological Studies.
**Budyko, M. M.**
**1977** *Global'naya ecologiya* [Global Ecology].Mysl', Moscow.
**Burov, G. M.**
**1966** Arkheologicheskiye nakhodki v starichnykh torfyanikakh basseina reki Vychegda [Archaeological Finds in the Loop Lakes of the Vychegda River Basin]. *SA* 1:155–173.
**1981** Drevniye sani Severnoi Evropy (tipologiya, khronologiya, arealy i evolutsiya) [Old Sledges of Northern Europe: Typology, Chronology, Distribution, and Evolution]. *Skandinavsky Sbornik* XXVI:151–171.
**Chapsky, K. K.**
**1940** Rasprostranenie morzha v moryakh Laptevykh i Vostochnosibirskom [Distribution of Walrus in the Laptev and East Siberian Seas]. *Problemy Arktiki* 6:80–94.
**Chard, Ch. S.**
**1962** Proiskhozhdeniye khozhyaistva morskikh okhotnikov severnoy chasti Tikhogo Okeana [Origin of the Economy of Sea-Mammal Hunters in the North Pacific]. *SE* 5:94–99.
**Chernetsov, V. N.**
**1935** Drevnyaya primorskaya kul'tura na poluostrove Yamal [Ancient Maritime Culture on the Yamal Peninsula] *SE* 4–5:109–133.
**1953** Drevnyaya istoriya Nizhnego Priob'ya [Ancient History of the Lower Ob' Region]. *MIA* 35:7–71.
**1957** Nizhneye Priob'ye v I tysyacheletii n.e. [The Lower Ob' Region in the First Millennium AD]. *MIA* 58:136–245.

**Chernov, G. A.**

**1940** Stoyanki na r. Kolve, Kolvavis i Sandibei-yu v Bol'shezemel'skoy tundre [Sites Discovered on the Kolva, Kolvavis, and Sandibei-yu Rivers in the Bol'shezemel'sk Tundra]. *KSIIMK* 9:101–110.

**1948a** Arkheologicheskiye nakhodki v Tsentral'noy chasti Bol'shezemel'skoy tundry [Archaeological Finds in the Central Part of the Bol'shezemel'sk Tundra]. *Trudy KIChP* VII(1):55–122.

**1948b** Stoyanki drevnego cheloveka v basseine r. Pechory [Ancient Sites in the Pechora River Basin]. *KSIIMK* 23:50–59.

**1985** *Atlas archaeologicheskikh pamyatnikov Bol'shezemel'skoy tundry* [Archaeological Atlas of the Bol'shezemel'sk Tundra]. Nauka, Moscow.

**Chernov, Yu. I.**

**1980** *Zhizn' tundry* [Living Tundra]. Mysl', Moscow.

**Chern'yavskiy, F. B.**

**1969** Kraniometricheskaya izmenchivost' belogo medved'ya (Ursus maritimus Phipps.1774) Sovetskoy Arktiki [Craniometrical Variability of the Polar Bear (*Ursus maritimus* Phipps.1774) of the Soviet Arctic]. In *Belyi medved' i ego zaschita v Sovetskoy Arktike,* pp. 54–67. Gidrometeoizdat, Leningrad.

**Chersky, I. D.**

**1872** Neskol'ko slov o vyrytykh v Irkutske izdeliyakh kamennogo veka [Some Words on the Stone Age Implements Excavated in Irkutsk]. *IVSORGO* 3(3).

**1891** Opisanie kollektsiy posletretichnykh mlekopitayuschikh zhivotnikh, sobrannykh Novo-Sibirskoy ekspeditsiey 1885–1886 gg. [A Description of Post-Tertiary Mammals, Collected by the New-Siberian Expedition in 1885–1886]. *Zapiski Akademii Nauk* 65(1):1–706.

**Chikachev, A. G.**

**1990** *Russkie na Indigirke* [Russians on the Indigirka River]. Nauka, Novosibirsk.

**Chizhov, O. P., V. S. Koryakin, and N. V. Davidovich**

**1968** *Oledeneniye Novoy Zemly* [Glaciation of the Novaya Zemlya Islands]. Nauka, Moscow.

**Chuvardinsky, V. G.**

**1992** K probleme oledeneniya shel'fa Belogo morya v pleistotsene [On the Problem of Pleistocene Glaciation of the White Sea Shelf]. In *Problemy kainozoiskoy paleogeografii i paleoekologii morey Severnogo Ledovitogo okeana,* pp. 117–125. Nauka, Moscow.

**Danilov, I. D.**

**1978** *Pleistotsen morskikh subarkticheskikh ravnin* [The Pleistocene of the Subarctic Coastal Plains]. Nauka, Moscow.

**1982** Problema sootnosheniya oledeneniy i morskikh transgessiy v pozdnem kainozoye [The Problem of the Correlation of Glacials and Oceanic Transgressions in the Late Cenozoic Era]. *Vodnye resursy* 3:119–135.

**1988** Problemy pozdnechetvertichnoi istorii Barentseva i Karskogo morei [Problems of the Late Quaternary History of the Barents and Kara Seas]. In *Chetvertichnaya paleoecologiya i paleogeografiya Severnykh morei,* pp. 73–82. Nauka, Moscow.

**1989** Paleoklimaty pozdnego pleistotsena i golotsena Severa Sibiri [Paleo-Climates of the Late Pleistocene and Holocene in the Siberian North]. In *Pleistotsen Sibiri i Severo-Vostoka SSSR,* pp. 146–161. Nauka, Novosibirsk.

**Danilov, I. D., and O. B. Parunin**

**1982** Sravnitel'nye resul'taty radiouglerodnogo datirovaniya carbonatnykh konkretsiy i rastitel'nykh ostatkov iz verkhnepleistotsenovykh otlozheniy karginskoi terrasy nizov'yev Yeniseya [Comparative Results of Carbon-14 Dating of Carbonate Concretions and Carbofossils from Upper Pleistocene Deposits Comprising the Karga Terrace on the Lower Reaches of the Yenisei River]. *DAN SSSR* 262(2):402–404.

**Danilov, I. D., and E. I. Polyakova**

**1989** Paleoklimat pozdnelednikov'ya i golotsena Severa Zapadnoi Sibiri i Pechorskoi nizmennosti [Paleo-Climate of the Late Pleistocene and Holocene of the West Siberian North and Pechora Lowland]. In *Paleoklimaty pozdnelednikov'ya i golotsena,* pp. 141–145. Nauka, Moscow.

**Debetz, G. F.**

**1951** Proiskhozhdeniye korennogo naseleniya Ameriki [The Origin of Native Americans]. *TIE* XVI:523–538.

**Degtyarenko, Yu. P., A. P. Puminov, and G. M. Blagoveschensky**

**1982** Beregovye linii vostochno-arkticheskikh morei v pozdnem pleistotsene i golotsene [Late Pleistocene and

Holocene Shorelines of the Eastern Arctic Seas]. In *Kolebaniya urovnya morei i okeanov za 15.000 let* [Sea and Ocean Level Fluctuations for 15,000 Years], pp. 179–185. Nauka, Moscow.

**Dibner, V. D.**

**1970** Geomorfologiya [Geomorphology]. In *Sovetskaya Arktika. Morya i ostrova,* pp. 59–107. Nauka, Moscow.

**Dikov, N. N.**

**1960** *Po sledam drevnikh kostrov* [Following Ancient Fires]. Magadan.

**1971** Drevniye kul'tury Kamchatki i Chukotki [Ancient Cultures of Kamchatka and Chukotka]. Avtoreferat dokt. diss., Novosibirsk.

**1976a** Noveishiye issledovaniya paleolita na Kolyme i Kamchatke i problema pervonachal'nogo zaseleniya Ameriki [The Latest Research in the Kolyma River Area and Kamchatka Peninsula and the Problem of the Initial Human Occupation of America]. *Trudy SVKNII DVNTs AN SSSR* 67:165–182.

**1976b** O nekotorykh obschikh printsipakh arkheologicheskoi periodizatsii [Some General Principles of Archaeological Periodization]. *Trudy SVKNII DVNTs AN SSSR* 67:218–224.

**1977** *Arkheologicheskiye pamyatniki Kamchatki, Chukotki i Verkhnei Kolymy* [Archaeological Sites in Kamchatka, Chukotka, and the Upper Reaches of the Kolyma]. Nauka, Moscow. [In translation: *Archaeological Sites of Kamchatka, Chukotka, and the Upper Kolyma*. Beringian Shared Heritage Program, National Park Service, Anchorage, Alaska. 2003.]

**1979** *Drevniye kul'tury Severo-Vostochnoi Azii. Aziya na styke s Amerikoi v drevnosti* [Ancient Cultures of Northeast Asia. Asia Joining America in Ancient Times]. Nauka, Moscow. [In translation: *Early Cultures of Northeast Asia*. Beringian Shared Heritage Program, National Park Service, Anchorage, Alaska. 2004.]

**1980** Pervye paleoliticheskiye pamyatniki na Chukotskom poluostrove (stoyanki na rekakh Chel'kun i Kurupke) [The First Paleolithic Sites on the Chukchi Peninsula. Sites on the Chel'kun and Kurupka Rivers]. In *Noveishiye dannye po arkheologii Severa Dal'nego Vostoka,* pp. 5–23. Magadan.

**1985** Ul'khum i Chaatam'e I—novye paleoliticheskiye mestonakhozhdeniya na yugo-vostoke Chukotskogo poluostrova [The Ulkhum and Chaatam'e I Sites—New Paleolithic Sites in the Southeastern Part of Chukchi Peninsula]. In *Novoye v arkheologii Severa Dal'nego Vostoka,* pp. 3–11. Magadan.

**1990** Osnovnye resul'taty arkheologicheskikh razvedok na vostoke Chukotskogo poluostrova v 1979–1986 gg [Major Results of Archaeological Research on the Eastern Chukchi Peninsula]. In *Drevniye pamyatniki Severa Dal'nego Vostoka* [Prehistoric Sites of the Northern Soviet Far East], pp. 7–35. Magadan.

**1993a** *Aziya na styke s Amerikoi v drevnosti (Kamenny vek Chukotskogo poluostrova)* [Asia at the Joint with America. Stone Age of the Chukchi Peninsula]. Nauka, St. Petersburg. [In translation: *Asia at the Juncture with America*. Beringian Shared Heritage Program, National Park Service, Anchorage, Alaska. 1997.]

**1993b** *Paleolit Kamchatki i Chukotki v svyazi s problemoi pervonachal'nogo zaseleniya Ameriki* [Paleolithic of Kamchatka and Chukotka]. Magadan.

**Dikov, N. N., and G. I. Kazinskaya**

**1980** Sledy kamennogo veka na reke Kurupke, Chukotsky poluostrov [Evidence of Stone Age Occupation on the Kurupka River, Chukchi Peninsula]. In *Noveishiye dannye po arkheologii Severa Dal'nego Vostoka,* pp. 24–37. Magadan.

**Dolgikh, B. O.**

**1952** Proiskhozhdeniye nganasanov [Origin of the Nganasans]. *TIE* XVIII:5–87.

**Dolukhanov, P. M.**

**1982** Prirodnaya sreda i khozyaistvennaya deyatel'nost' v pozdnem pleistotsene i golotsene [Natural Environment and Primitive Economy in the Late Pleistocene and Holocene]. Avtoreferat dokt. diss., Leningrad.

**Druri, I. V.**

**1949** Dikiy severny olen' Sovetskoi Arktiki i Subarktiki [Wild Reindeer in the Soviet Arctic and Subarctic]. *Trudy ANII* 200.

**Easton, A. N.**

**1992** Mal de Mer Above Terra Incognita, or, "What Ails the Coastal Migration Theory?" *Arctic Anthropology* 29(2):28–41.

**Eding, D. N.**

**1929** *Gorbunovskiy torfyanik* [The Gorbunovo Peatbog]. Materialy po izucheniyu Tagil'skogo okruga. Vyp. 3(1).

**Egorov, O. V.**

**1969** Ostatki fauny iz mnogosloinoi stoyanki Bel'kachi I [Faunal Remains from the Belkachi I Stratified Site].

Appendix to: Mochanov, Yu.A. *Mnogosloinaya stoyanka Bel'kachi I i periodizatsiya kamennogo veka Yakutii,* pp. 202–204. Nauka, Moscow.

**Ermolayev, M. M.**

**1932** Istoriya otkrytiya Novosibirskogo arkhipelaga, ego issledovaniya i razvitiya ostrovnykh promyslov [The History of the Discovery and Survey of the New Siberian Archipelago]. In *Polyarnaya geofizicheskaya stantsiya na ostrove Bol'shom Lyakhovskom,* pp. 148–158. Leningrad.

**Evseyev, V. P., I. A. Dubrovo, N. V. Rengarten, and A. Ya. Stremyakov.**

**1982** Mestonakhozhdeniye Yuribeiskogo mamonta: geologiya, tafonomiya, paleogeografiya [Location of the Yuribei Mammoth Find: Geology, Taphonomy, Paleogeography]. In *Yuribeisky Mamont,* pp. 5–19. Nauka, Moscow.

**Fainberg, L. A.**

**1971** *Ocherki etnicheskoy istorii zarubezhnogo Severa (Alyaska, Kanadskaya Arktika, Labrador, Grenlandiya)* [Essays on the Ethnic History of the Foreign North (Alaska, Canadian Arctic, Labrador, Greenland)]. Nauka, Moscow.

**Fedoseyeva, S. A.**

**1968** Drevniye kul'tury Verkhnego Vilyuya [Ancient Cultures of the Upper Vilyui Area]. Nauka, Moscow.

**1980** *Ymiyakhtakhskaya kul'tura Severo-Vostochnoy Azii* [The Ymiyakhtakh Culture of Northeast Asia]. Nauka, Novosibirsk.

**1984** Ymiyakhtakhskaya kul'tura Severo-Vostochnoy Azii [The Ymiyakhtakh Culture of Northeast Asia]. Avtoreferat dokt. diss., Novosibirsk.

**Filippov, A. K.**

**1978** Tekhnologiya izgotovleniya kostyanykh nakonechnikov v verkhnem paleolite [Paleolithic Technology for Manufacturing Bone Points]. *SA* 2:23–32.

**Formozov, A. A.**

**1970** O termine "mezolit" i yego equivalentakh [The Term "Mesolithic" and Its Equivalents]. *SA* 3:6–13.

**Foss, M. E.**

**1952** Drevneyshaya istoriya Severa Evropeyskoy chasti SSSR [The Ancient History of the European Northeast of the USSR]. *MIA* 29.

**Fitzhugh, W. W.**

**1973** Comparative Approach to Northern Maritime Adaptations. *IX International Congress of Anthropological and Ethnological Sciences,* pp. 341–385. Chicago.

**Flor, F.**

**1930** Haustiere und Hirtenkulturen. Kulturgeschichtliche Entwicklungumrisse [Domestic Animals and Herding Cultures. Outlines of the Development of Cultural History]. Wien *Beiträge zur Kulturgeschichte und Linguistik*. Veroffentlichungen des Instituts fur Volkerkunde und Universitat Wien. 1.

**Gedenstrom, M.**

**1822** Puteshestviye Gedenshtroma vdol' poberezh'ya Ledovitogo okeana [Gedensshrom's Voyage along the Arctic Coast]. *Sibirsky vestnik* Ch. 17–19:171–378.

**Gerasimov, I. P., and K. K. Markov**

**1939** Lednikovy period na territorii SSSR [Ice Age in the Territory of the USSR]. *Trudy IG AN SSSR* 33.

**Giria, E. Yu.**

**1993** Tekhnologichesky analiz plastinchatykh industriy [Technological Studies of Blade Industries]. Avtoreferat kand. diss., St. Petersburg.

**Giria, E. Yu., and V. V. Pitul'ko**

**1992** Vkladyshevye orudiya v paleolite—mezolite Sibiri [Compound Tools in the Paleolithic and Mesolithic Cultures of Siberia]. In *Arsen'yevskiye chteniya,* pp. 161–165. Ussuriisk.

**1993** Izdeliya iz bivnya mamonta pozdnepleistotsenovykh i rannegolotsenovykh pamyatnikov Severo-Vostochnoi Azii i Sibirskoi vysokoshirotnoi Arktiki: istochniki syrya i priemy obrabotki [Late Pleistocene and Early Holocene Evidence of the Use of Mammoth Bones by the Natives of the Siberian High Arctic and Neighboring Territories]. In *Istorichesky opyt osvoyeniya Vostochnykh regionov Rossii,* pp. 33–36. Vladivostok.

**1994a** Mezoliticheskiye industrii Severo-Vostoka Azii [Mesolithic Industries of Northeast Asia]. In *Evropeisky Sever: vzaimodeistviye kultur v drevnosti i srednevekov'ye,* pp. 29–31. Syktyvkar.

**1994b** High Arctic Mesolithic Culture of Zhokhov Island: Insert Tools and Knapping Technology. *Arctic Anthropology* 31(2):17–29.

**Giterman, R. E., L. V. Golubeva, and E. D. Zaklinskaya**
**1968** *Osnovnye etapy razvitiya rastitel'nosti Severnoy Azii v antropogene* [Major Stages of Vegetation Development in Northern Asia during the Anthropogene]. Nauka, Moscow.
**Glushinsky, P. I., and L. P. Khlobystin**
**1966** Buolkalaakh—novaya stoyanka drevnego cheloveka na Krainem Severe Sibiri [Buolkalaakh—A New Prehistoric Site in the Extreme Siberian North]. *SAS* 1:151–159.
**Glushkova, O. Yu., and T. P. Prokhorova**
**1987** Osobennosti formirovaniya pozdnepleistotsenovykh oledeneniy i osadkonakopleniya v basseine r. El'gen'i, Verkhne-Kolymskoye nagor'ye [Features of the Formation of Late Pleistocene Glacials and Sedimentation in the Elgeni River Basin, Upper Kolyma Mountains]. In *Chetvertichny period Severo-Vostoka Azii,* pp. 68–90. Magadan.
**Goryunova, O. Yu.**
**1978** Ranniye kompleksy mnogosloinogo poseleniya Ityrkhei [Early Complexes of the Ityrkhei Stratified Site]. *DINYuVS* 1:56–61.
**1987** Raboty Malomorskogo otryada na Baikale [A Baikal Survey by the Malomorsky Field Team]. In *Issledovaniya pamyatnikov drevnikh kultur Sibiri i Dal'nego Vostoka*, pp. 133–140. Nauka, Novosibirsk.
**Graebner, F.**
**1911** *Methode der Ethnologie* [Ethnological Method].
**Greenman, E. F.**
**1963** The Upper Paleolithic and the New World. *Current Anthropology* 4(1):41–92.
**Grigor'yev, G. P.**
**1970** Verkhnii paleolit [The Upper Paleolithic]. *MIA* 166:43–63.
**Grishin, Yu. S.**
**1981** *Pamyatniki neolita, bronzovogo i rannego zheleznogo veka lesostepnogo Zabaikalya* [Neolithic and Bronze and Early Iron Age Sites in the Forest-Steppe of the Trans-Baikal Region]. Nauka, Moscow.
**Gronnow, B.**
**1988** Prehistory in Permafrost (Investigations at the Saqqaq Site, Qeqertasassuk, Disco Bay, West Greenland). *Journal of Danish Archaeology* 7:24–39.
**Grosswald, M. G.**
**1977** Poslednii Evroaziatsky lednikovy pokrov [The Last Eurasia Ice Cover]. *Materialy glatsiologicheskikh issledovaniy* 30:45–60.
**1982** O proiskhozdenii "zatonuvshikh beregovykh liniy" glatsial'nykh shel'fov Severnoy Atlantiki [On the Origin of "Submerged Shore Lines" of the North Atlantic Glacial Shelf]. In *Kolebaniya urovnya morei i okeanov za 15.000 let* [Sea and Oceanic Level Fluctuations for 15,000 years], pp. 125–133. Nauka, Moscow.
**1983** *Oledeneniye kontinental'nykh shelfov* [Glaciation of Continental Shelf Areas]. VINITI, Moscow.
**Grosswald, M. G., A. S. Lavrov, and L. M. Potapenko**
**1974** Lednikovaya stadiya markhida-velt: dvoinoi serdzh Barentsevomorskogo lednikovogo schita? [Glacier Advances Markhida and Velt: Twin Surges of the Barents Ice Sheet?]. *Materialy glaciologicheskikh issledovaniy* 24:173–188.
**Gryuger, E.**
**1973** Rastitel'nost' i klimat Tsentral'noi chasti Severnoi Ameriki v period poslednego oledeneniya [Vegetation and Climate of the Central Part of North America during the Last Glaciation]. In *Palinologiya pleistotsena i pliotsena,* pp. 171–174. Nauka, Moscow.
**Gurina, N. N.**
**1951** Neoliticheskiye poseleniya Kol'skogo poluostrova [Neolithic Sites of the Kola Peninsula]. *MIA* 20:143–167.
**1957** Nekotorye novye dannye o zaselenii Severa Evropeiskoi chasri SSSR [Some New Data on Human Occupation of the North of the European Part of the USSR]. *SA* 2:115–121.
**1971** Novye issledovaniya v severo-zapadnoi chasti Kol'skogo poluostrova [New Survey in the Northwestern Area of the Kola Peninsula]. *KSIA* 126:94–99.
**1973** Drevniye pamyatniki Kol'skogo poluostrova [Ancient Sites of the Kola Peninsula]. *MIA* 172:45–53.
**1987** The Main Stages in the Cultural Development of the Ancient Population of the Kola Peninsula. *Phennoscandia archaeologica* IV:35–48.
**1989** Mezolit Kol'skogo poluostrova [Mesolithic of the Kola Peninsula]. In *Mesolithic of the USSR,* pp. 20–26. Nauka, Moscow.

**Gurina, N. N., and L. P. Khlobystin**
**1974** Zaseleniye Arktiki [Human Occupation of the Arctic]. In *Pamyatniki kultury,* pp. 404–411. Ezhegodnik 1974 g. Nauka, Moscow.
**Guryanova, E. F**
**1948** *Beloye more i ego fauna* [The White Sea and Its Fauna]. Petrozavodsk.
**Guslitser, B. I., and P. Yu. Pavlov**
**1987** O pervonachal'nom zaselenii severo-vostoka Evropy (novye dannye) [On the Original Occupation of Northeastern Europe]. Pre-print series *Scientific Reports* 172.
**1988** Verkhnepaleoliticheskaya stoyanka Medvezh'ya peschera (novye dannye) [New Data on the Upper Paleolithic Bear Cave Site]. *MAESV* 11:5–18.
**Gvozdover, M. D.**
**1952** Vkladyshevy nakonechnik s paleoliticheskoi stoyanki Talitskogo [A Compound Point from the Talitski Paleolithic Site]. *UzPGU* 158:207–210.
**Hatt, G.**
**1934** North American and Eurasian Culture Connections. *Proceedings of the 5th Pacific Scientific Congress*. Toronto.
**Hopkins, D., T. Karlstrom, and R. Black**
**1958** Postoyannomerzlye porody i gruntovye vody Alyaski [Permafrost Deposits and Groundwater in Alaska]. In *Merzlye porody Alaski i Kanady,* pp. 39–105. Izd-vo Inostrannoi Literatury, Moscow.
**Hughes, T. J., G. H. Denton, and M. G. Grosswald**
**1977** Was there a Late Wurm Arctic Ice Sheet? *Nature* 266 (5603):596–602.
**Indrelid, S.A.**
**1975** Problems Dating to the Early Mesolithic Settlements of Southern Norway. *NAR* 8.
**Isayeva, L. L., N. V. Kind, and S. M. Andreyeva**
**1980** Geokhronologiya i paleogeografiya pozdnego pleistotsena Severo-Sibirskoi nizmennosti po radiouglerodnym dannym [Late Pleistocene Geochronology and Paleogeography of the Northern Siberian Lowland Based on Carbon-14 Dating]. In *Geokhronologiya chetvertichnogo perioda,* pp. 191–197. Nauka, Moscow.
**Ivanov, G. V.**
**1991** Stoyanka kamennogo veka na ostrove Vaigach [A Stone Age Site on Vaigach Island]. In *Problemy istoriko-kul'turnoi sredy Arktiki,* pp. 113–119. Moscow.
**1993** Nakhodki kamennykh orudiy na ostrovakh Evropeiskoi Arctiki [Finds of Stone Tools on the European Arctic Islands]. In *AD POLUS,* pp. 47–54. St. Petersburg.
**Ivanov, V. V., and V. M. Makeyev**
**1987** Rol' dolgoperiodnykh kolebaniy urovnya okeana i vertikal'nykh dvizheniy zemnoi kory v razvitii ust'evykh oblastei rek arkticheskoi zony [The Significance of Long-Term Sea-Level Fluctuations and Vertical Land Shifts for the Development of Arctic Estuaries]. *Vodnyye Resursy* 4:123–128.
**Ivashin, M. V., L. A. Popov, and A. S. Tsapko**
1972 *Morskiye mlekopitayuschiye* [Sea Mammals]. Pischevaya promyshlennost', Moscow.

**Ivashina, L. G.**
**1979** *Neolit i eneolit lesostepnoi zony Buryatii* [The Neolithic and Eneolithic of the Buryat Forest-Steppe Zone]. Nauka, Novosibirsk.
**Izbekov, E. D.**
**1982** K voprosu otsenki kolichestva oledeneniy po razlichnym criteriyam, na primere Priindigirskoi zony [On the Question of Identification of Glacials Based on Different Criteria: Indigirka Area]. In *Geologiya Kainozoya Yakutii,* pp. 140–149. Yakutsk.
**Jenness, D. (editor)**
**1933** *The American Aborigines: Their Age and Antiquity*. Toronto.
**Jessing, G.**
**1944** Circumpolar Stone Age. *Acta Arctica* Fasc. 11
**Jochelson, W.**
**1926** The Ethnological Problem of the Bering Sea. *Natural History* XXVI(1).
**Jonston, W. A.**
**1926** The Pleistocene of Cariboo and Cassiar Districts, British Columbia, Canada. *Royal Society of Canada Transactions* Ser. 3. 20(4).

**Kanivets, V. I.**
**1976** *Paleolit Krainego Severo-Vostoka Evropy* [The Paleolithic of the Extreme European Northeast Region]. Nauka, Moscow.
**Kaplina, T. V., and V. A. Lozhkin**
**1982** Istoriya razvitiya Primorskikh nizmennostei Yakutii v golotsene [The History of the Development of the Yakutian Coastal Lowlands in the Holocene]. In *Razvitiye prirody territorii SSSR v pozdnem pleistotsene i golotsene,* pp. 207–220. Nauka, Moscow.
**Kaplyanskaya, F. A., and V. D. Tarnogradsky**
**1975** Proiskhozdeniye sanchugovskoi tolschi i problema sootnosheniya oledeneniy i morskikh transgressiy na Severe Zapadnoi Sibiri [The Origin of the Sanchug Cover and the Problem of the Correlation of Glacials and Oceanic Transgressive Stages in the West Siberian North]. In *Kolebaniya urovnya Mirovogo Okeana v pleistotsene,* pp. 53–95. Leningrad.
**Karpellan, K.**
**1979** Finskiye saamy v zheleznom veke [Finnish Saami in the Iron Age]. In *Finno-ugry i slavyane,* pp. 143–151. Nauka, Leningrad.
**Karpovich, V. N.**
**1969** Razmescheniye belogo medved'ya v Sovetskoy Arktike po dannym korrespondentskoy seti [Spatial Distribution of Polar Bears in the Soviet Arctic According to a Viewer's Information]. In *Belyi medved' i ego zaschita v Soveskoy Arktike,* pp. 26–33. Gidrometeoizdat, Leningrad.
**Kashin, V. A.**
**1983** Istoriya i nekotorye itogi izucheniya geologii paleolita Yakutii [History and Some Results of Geological Studies of the Yakutian Paleolithic]. In *Paleolit Sibiri,* pp. 111–124. Nauka, Novosibirsk.
**Kasparov, A. K.**
**1986** Ostatki mlekopitayuschikh iz pozdnepaleoliticheskogo poseleniya Sukhotini IV v Zabaikal'ye [Faunal Remains from the Late Paleolithic Sukhotino IV Site in the Trans-Baikal Area]. *Trudy ZIN* 149:98–106.
**1989** Mammals from the Eneolithic Settlement Ilgyynly Depe. *Proceedings of the Academy of Science of the Turkmen SSR. Series of Social Sciences* 6:24–28.
**Kasparov, A. K., and V. V. Pitul'ko**
**1993** Drevniye okhotniki vysokoshirotnoi Arktiki: material'naya kul'tura i strategiya zhizneobespecheniya [Ancient Hunters of the High Arctic: Material Culture and Survival Strategy]. In *TD PKIKN,* pp. 39–43. St. Petersburg.
**Katasonova, E. G., and Kh. G. Zigert**
**1982** Sklonovye otlozheniya v dolinakh malykh rek Tsentral'noi Yakutii [Slope Deposits in the Small River Valleys of Central Yakutia]. In *Geologiya kainozoya Yakutii,* pp. 122–131. Yakutsk.
**Khlobystin, L. P.**
**1967** Arkheologicheskiye issledovaniya na Severe Zapadnoi Sibiri [Survey in Northwestern Siberia]. *AO* 1966:147–149.
**1970** Novye pamyatniki basseina rek Anabara i Oleneka [New Archaeological Sites on the Anabar and Olenek Rivers] *MIS* 3:174–179.
**1972a** Poseleniye razvitogo neolita Maymeche I i ego mesto v neolite Vostochnoy Sibiri [The Perfect Neolithic Maimeche I Site and Its Place in the Eastern Siberian Neolithic]. *KSIA* 131:99–106.
**1972b** Rogovye i kostyanye izdeliya paleoliticheskikh sloyev Biryusinskogo poseleniya [Antler and Bone Artifacts from the Paleolithic Layers of the Birusa Site]. *MIA* 185:150–156.
**1973a** Drevneyshiye pamyatniki Zapadnogo Taimyra [The Ancient Sites of the Western Taimyr]. *KSIA* 137:89–95.
**1973b** Krainiy Severo-Vostok Evropeiskoi chasti SSSR v epokhu neolita i rannei bronzy [The Extreme Northeast of the European Part of the USSR in the Neolithic and the Early Bronze Age]. *MIA* 172:54–65.
**1973c** O drevnem zaselenii Arktiki [Ancient Human Occupation of the Arctic]. *KSIA* 136:11–16.
**1978** Vozrast i sootnoshenie neoliticheskikh kul'tur Vostochnoi Sibiri [The Age and Correlation of the East Siberian Neolithic Cultures]. *KSIA* 153:93–99.
**1982** Drevnyaya istoriya Taimyrskogo zapolyarya i voprosy formirivaniya kul'tur Krainego Severa Evrazii [The Ancient History of the Taimyr Trans-Polar Region and Questions of the Formation of Cultures in the Eurasian Extreme North]. Avtoreferat dokt. diss., Moscow.

**1986** Raboty na o. Vaigach i Yugorskom poluostrove [Field Survey on Vaigach Island and the Yugorsky Peninsula]. *AO* 1984:32–33.
**1987a** Raboty v Arkhangel'skom Zapolyar'y [Survey in the Arkhangelsk Trans-Polar Area]. *AO* 1985:40–42.
**1987b** Nakhodki bliz g. Salekharda [Finds near Salekhard Town]. *KSIA* 189:108–111.
**1991** 200 let arkticheskoi arkheologii [The Two-Hundred Year Anniversary of Arctic Archaeology]. *KSIA* 200:3–8.

**Khlobystin, L. P., and Yu. S. Korolev**
**1969** Iorkutinskaya stoyanka na poluostrove Yamal [The Iorkuta Site on the Yamal Peninsula]. *KSIA* 115:79–83.

**Khlobystin, L. P., and G. M Levkovskaya**
**1973** Osnovnye etapy razvitiya prirody i kul'tury drevnikh obschestv v Sibirskoi Arktike [Major Stages of Natural Evolution and the Culture of Primitive Societies in the Siberian Arctic]. In *Prehistoric Man, His Material Culture and Natural Environment in the Pleistocene and Holocene,* pp. 91–94. Nauka, Moscow.

**Khlobystin, L. P. and V. V. Pitul'ko**
**1991** Mnogosloinoe poselenie Mys Vhodnoy [Cape Vhodnoy multi-component stratified site]. *Drevnosti Russkogo Severa* 1:122-133.

**Khlobystin, L. P., and N. P. Pyadyshev**
**1962** Novaya stoyanka v Pechorskom Zapolyar'ye [A New Archaeological Site in the Pechora Trans-Polar Area]. *KSIA* 92:71–75.

**Khlobystin,** L. P., and S. V. Studzitskaya
**1976** Drevniye pamyatniki na zapade plato Putorana [Ancient Sites in the Western Part of the Putorana Plateau]. *KSIA* 147:62–67.
**1987** Otchet o polevykh issledovaniyakh Zapolyarnoi ekspeditsii v 1987 g. [Trans-Polar Expedition. Report on Surveying in 1987]. Arkhiv IIMK RAN, KP 4205 [Archive of the Institute for Material Culture History]. St. Petersburg.

**Khlobystin, L. P., I. V. Vereschagina, and V. Ya. Shumkin**
**1988** Issledovaniya Zapolyarnoi ekspeditsii [Field Survey of the Trans-Polar Expedition]. *AO* 1987:41–45.

**Khol'tedal', U.**
**1957** *Geologiya Norvegii*. Tom 2. [Geology of Norway. Vol. 2]. Inostrannaya Literatura, Moscow.

**Khotinsky, N. A.**
**1977** *Golotsen Severnoi Evrazii* [The Holocene of Northern Eurasia]. Nauka, Moscow.
**1978** Paleogeograficheskiye osnovy datirovki i periodizatsii neolita lesnoi zony Evropeiskoi chasti SSSR [Paleogeographic Grounds for Dating and Periodization of the Neolithic in the Forest Belt Area of the European Part of the USSR]. *KSIA* 153:7–14.

**Kind, N. V.**
**1974** *Geokhronologiya pozdnego antropogena po izotopnym dannym* [Geochronology of the Late Anthropogene According to Isotope Dating]. Nauka, Moscow.

**Kind, N. V., L. D. Sulerzhitsky, and S. N. Vinogradova**
**1978** Radiouglerodnye daty GIN AN SSSR. Soobscheniey IX. Aziatskaya chast' SSSR: Zapadny Taimyr [Radiocarbon Dates by GIN RAS. Information IX. The Asian Part of the USSR: West Taimyr]. *BKIChP* 48:191–199.
**1981** Radiouglerodnye daty GIN AN SSSR. Soobscheniey X. [Radiocarbon Dates by GIN RAS. Information X.]. *BKIChP* 51:184–189.

**Kirillov, I. I., and O. G. Verkhoturov**
**1985** Novye neoliticheskiye mogil'niki iz vostochnogo Zabaikal'ya i ikh znacheniye v opredelenii ethnokul'turnykh svyazey mestnykh plemen [New Neolithic Burial Grounds in the Trans-Baikal Region and Their Significance for Consideration of Ethnic and Cultural Interactions between Local Tribes]. In *Drevneye Zabaikal'ye i yego kulturnye svyazi,* pp. 7–21. Nauka, Novosibirsk.

**Kiryak, M. A.**
**1980** Pervye arkheologicheskiye razvedki v basseine r. Mal. Anyui [The First Archaeological Survey in the Maly Anyui River Basin]. In *Noveyshiye dannye po arkheologii Severa Dal'nego Vostoka,* pp. 38–41. Magadan.
**1983** Otchet Zapadno-Chukotsko-Kolymskogo arkheologicheskogo otryada o polevykh issledovaniyakh v 1983 g. Arkhiv IA RAN, r-1, N 9998 [Field Report on the Western Chukotka and Kolyma Survey in 1983. Archive of the Institute for Archaeology, Moscow].

**1989a** Otchet o polevykh arkheologicheskikh issledovaniyakh na Zapadnoi Chukotke v 1989 g. Arkhiv IA RAN, r-1, N 11736 [Field Report on the Survey of Western Chukotka in 1989. Archive of the Institute for Archaeology, Moscow].

**1989b** Arkheologiya Zapadnoi Chukotki, Srednego i Nizhnego Prikolym'ya i nekotorye voprosy etnogeneza yukagirov [Archaeology of Western Chukotka, Middle and Lower Kolyma Areas, and Some Questions of the Yukagir Ethnogenesis]. Avtoreferat kand. diss., Leningrad.

**1993** *Arkheologiya Zapadnoi Chukotki* [Archaeology of Western Chukotka]. Nauka, Moscow.

**Kistenev, S. P.**

**1982** Novyiye arkheologicheskiye pamyatniki basseyna Kolymy [New Archaeological Sites in the Kolyma River Basin]. In *Novoiye v arkheologii Yakutii,* pp. 74–95. Yakutsk.

**Knuth, E. A.**

**1962** Report on the 1st Peary Land Expedition. *Polar Record* 6(44).

**Kozlov, V. I.**

**1980** Novye arkheologicheskiye pamyatniki Amgi [New Archaeological Sites in the Amga River Area]. In *Novoye v arkheologii Yakutii,* pp. 55–61. Yakutsk.

**Kol'tsov, L. V.**

**1979** O kharaktere slozheniya rannemezoliticheskikh kul'tur Severnoy Evropy [On the Character of Mesolithic Cultural Development in Northern Europe]. *SA* 4:15–25.

**1984** Nekotorye aspekty mezoliticheskoy ekonomiki lesnoy zony Evropy [Some Questions on Mesolithic Subsistence Patterns in the Forest Zone of Europe]. *KSIA* 180:79–84.

**1989** Vvedeniye [Introduction]. In *Mezolit SSSR,* pp. 5–10. Nauka, Moscow.

**Konopatsky, A. K.**

**1982** *Drevniye kul'tury Baikala* [Ancient Cultures of the Baikal Area]. Nauka, Novosibirsk.

**Konstantinov, M. V.**

**1983** Final'ny paleolit Zapadnogo Zabaikalya [The Terminal Paleolithic in the Western Trans-Baikal Area]. In *Pozdnepleistotsenovye i rannegolotsenovye kul'turnye svyazi Azii i Ameriki,* pp. 102–110. Novosibirsk.

**Koryakin, V. S.**

**1988** *Ledniki Arktiki* [Arctic Glaciers]. Nauka, Moscow.

**Kosarev, M. F.**

**1984** *Zapadnaya Sibir' v drevnosti* [Western Siberia in Ancient Times]. Nauka, Moscow.

**Krasnozhen, A. S., O. F. Baranovskaya, and V. F. Zarkhidze**

**1982** Verkhnechetvertichnye otlozheniya Yuzhnogo ostrova Novoy Zemli [Late Quaternary Deposits on Yuzhnoe Island of the Novaya Zemlya Islands]. In *Stratigrafiya i paleogeografiya pozdnego kainozoya Arktiki,* pp. 40–52. Nauka, Leningrad.

**Krupnik, I. I.**

**1989** *Arctic Ethno-Ecology*. Nauka, Moscow.

**Kulik, I. A.**

**1914** Predvaritel'ny otchet o poezdke v Bol'shezemel'skuyu tundru letom 1910 g [Preliminary Report on a Trip to the Bolshezemelskaya Tundra in Summer 1910]. *Zapiski mineralogicheskogo obschestva* Series 2, 51:26–34.

**1915** Poezdke v Bol'shezemel'skuyu tundru letom 1910 g [A Trip to the Bolshezemelskaya Tundra in Summer 1910]. *Trudy obschestva zemlevedov pri SPb Universitete* III:45–61.

**Kurten, B.**

**1964** The Evolution of the Polar Bear, *Ursus maritimus* Phipps. *Acta Zoologica Fennica* 108(30).

**Kuzmina, I. E.**

**1971** Formirovanie teriofauny Severnogo Urala v pozdnem antropogene [Formation of Mammals of Northern Ural Area in the Late Anthropogene]. *Trudy ZIN* 49:44–122.

**1975** Nekotorye dannye o mlekopitayuschikh Srednego Urala v pozdnem pleistocene [Some Data on Late Pleistocene Mammals from the Northern Ural Area]. *BKChP* 43:63–77.

**Kuznetsov, A. M.**

**1988** Kamenny vek Alaski: problemy paleolita i mezolita [The Stone Age in Alaska: Problems of the Paleolithic and Mesolithic]. In *Ocherki tikhookeanskoi arkheologii,* pp. 60–100. Vladivostok.

**Kyakshto, N. B.**

**1926** Kamennye veschestvennye pamyatniki na Aldane [Stone Artifacts in the Aldan Area]. *Problemy istorii dokapitalisticheskikh obschestv* 7–8:8, 9.

**Lamartinyer, P.**
**1912** Puteshestviye v Severnye strany (1653) [Voyage to North Lands (1653)]. *ZMAI* XVI.
**Laricheva, I. P.**
**1976** *Paleoindeiskiye kul'tury Severnoi Ameriki* [Paleoindian Cultures of North America]. Nauka, Novosibirsk.
**Larsen, H.**
**1968** Trail Creek. *Acta Arctica* 15.
**Lashuk, L. P., and L. P. Khlobystin**
**1986** Sever Zapadnoi Sibiri v epokhu bronzy [The West Siberian North in the Bronze Age]. *KSIA* 185:43–50.
**Laukhin, S. A., N. N. Drozdov, V. A. Panychev, and S. V. Velichko**
**1989** Vozrast poslednego oledeneniya na severe Vostochnoy Chukotki [Dating the Last Glaciation in Eastern Chukotka]. *Izvestiya AN SSSR* Seriya geologii 3:136–140.
**Lavrov, A. S.**
**1977** Kol'sko-Mezensky, Barentsevomorsko-Pechorsky, Novozemel'sko-Kolvinsky lednikovye potoki [Kola-Mezen, Barents-Pechora, Novaya Zemlya-Kolva Ice Distributaries]. In *Struktura i dinamika poslednego lednikovogo pokrova Evropy,* pp. 83–100. Nauka, Moscow.
**Lavrov, A. S., and Kh. A. Arslanov**
**1977** Vozrast i genesis terras Pechorskoi nizmennosti: novye geokhronologicheskiye i radiouglerodnye dannye [Age and Genesis of Pechora Lowland Terraces: New Data on Geochronology and Isotope Dating]. *Rechnye sistemy i melioratsiya* 41:34–47.
**Lavrushin, Yu. A.**
**1969** *Chetvertichnye otlozheniya Shpitzbergena* [Quaternary Deposits on Spitsbergen]. Nauka, Moscow.
**Lazukov, G. I.**
**1972** Problema pleistotsenovogo oledeneniya shelfovykh morei Arkticheskogo basseina [Problems of Pleistocene Glaciation of the Arctic Shelf Zone]. *Vestnik MGU*, series 5, geography 5:38–45.
**Levin, M. G.**
**1946** Proiskhozhdenii i tipakh upr'yazhnogo sobakovodstva [On the Origin and Typology of Dog Traction]. *SE* 4:75–108.
**Lozhkin, V. A.**
**1976** Rastitel'nost' zapadnoy Beringii v pozdnem pleistotsene i golotsene [Vegetation of Western Beringia in the Late Pleistocene and Holocene]. In *Beringia v kainozoye,* pp. 29–32. Vladivostok.
**1977** Usloviya obitaniya berelekhskoy populyatsii mamontov [The Natural Environment of the Berelekh Mammoths]. *Trudy ZIN* 72:67–80.
**Luzgin, V. E.**
**1973a** Neoliticheskiye stoyanki Tsentral'nogo Timana [Neolithic Sites in the Central Timan Region]. *MAESV* 4:24–46.
**1973b** Poseleniye Ruzhnikova na Kosminskikh ozerakh i voprosy neolita Evropeiskogo Severo-Vostoka [The Ruzhnikova Dwelling Site on Kosminsk Lakes and Questions of the Neolithic of the European Northeast]. *MAESV* 5:22–34.
**Lynsha, V. A.**
**1978** Mezolit—ponyatiye arkheologicheskoy periodizatsii [Mesolithic as a Subdivision of Archaeological Periodization]. In *Arkheologiya i etnografiya Vostochnoy Sibiri,* pp. 93–96. Irkutsk.
**Machinsky, A. V.**
**1941** Drevnyaya eskimosskaya kul'tura na Chukotskom poluostrove [Ancient Eskimo Culture on the Chukchi Peninsula]. *KSIIMK* 9:80–89.
**Makeyev, V. M.**
**1983** Istoriya prilednikovykh ozer Severnoy Zemli [The History of Periglacial Lakes of Severnaya Zemlya Islands]. In *Istoriya ozer v SSSR,* Tom 1, pp. 122, 123. Tallinn.
**Makeyev, V. M., Kh. A. Arslanov, and V. E. Garutt**
**1979** Vozrast mamontov Severnoy Zemli i nekotorye voprosy paleogeografii pozdnego pleistotsena [The Age of Mammoth Skeletal Remains from the Severnaya Zemlya Islands and Some Questions on Late Pleistocene Paleogeography]. *DAN SSSR* 245 (2):421–424.
**Makeyev, V. M., Kh. A. Arslanov, O. F. Baranovskaya, A. V. Kosmodamianskiy, D. P. Ponomaryova, and T. V. Tertychnaya**
**1989** Stratigrafiya, geokhronologiya i paleogeografiya pozdnego pleistotsena i golotsena ostrova Kotel'nyy

[Stratigraphy, Geochronology, and Paleogeography of the Late Pleistocene and Holocene of Ostrov Kotel'nyy]. *BKChP* 58:58–69.

**Makeyev, V. M., D. Yu. Bol'shiyanov, and D. B. Malakhovskiy**

**1982** Stratigrafiya i geokhronologiya pozdnepleistotsenovykh otlozheniy Severnoy Zemly [The Structure and Geochronology of the Late Pleistocene Deposits on the Severnaya Zeml'ya Islands]. In *Geokhronologiya chetvertichnogo perioda,* pp. 132–137. Nauka, Moscow.

**Makeyev, V. M., and V. V. Pitul'ko**

**1991** Novyiye dannyiey o prirodnykh usloviyakh v kontse pozdnego pleistotsena—nachale rannego golotsena v vysokoshirotnoy aziatskoy Arktike i vremeni yeyo zaseleniya drevnim chelovekom [New Data on the Late Pleistocene/Holocene Natural Environment of the Asian High Arctic and the Early Human Occupation of the Region]. *DAN SSSR* 319(2):435–437.

**Makeyev, V. M., V. V. Pitul'ko, and A. K. Kasparov**

**1992** Ostrova De-Longa: An Analysis of Paleoenvironmental Data. *Polar Record* 28(167):301–306.

**Mannerfelt, A.**

**1945** Nogra glacial-morfologiska formelment och deras vittnesbord om inlandsisens avsmaltingsmehanik i svensk och norsk fjallterrang. *Geogr. Ann*. 27(1–2).

**Markov, K. K., and A. A. Velichko**

**1967** *Chetvertichny period*. Tom 3 [The Quaternary. Vol. 3]. Nauka, Moscow.

**Mason, O. T.**

**1894** *Primitive Travel and Transportation,* pp. 240–593. Annual Report of the Smithsonian Institution. Washington.

**Matishov, G. G., and L. G. Pavlova**

**1988** Aktual'nye problemy paleogeografii i paleoekologii severnykh morey v chetvertichny period [Topical Problems of Paleogeography and Paleoecology of the Quaternary]. In *Problemy chetvertichnoy paleogeografii i paleoekologii severnykh morey,* pp. 5–27. Nauka, Moscow.

**Matyushin, G. N.**

**1976** *Mezolit Yuzhnogo Urala* [The Mesolithic of the South Ural Region]. Nauka, Moscow.

**Medvedev, G. I.**

**1966** Novye dannye o nizhnikh sloyakh Ust-Beloy [New Data on the Lower Strata of the Ust-Belaya Site]. *SAS* 2:41–47.

**1980** *Mezolit Verkhnego Priangar'ya. Stoyanki Irkutskogo raiona* [The Mesolithic of the Upper Angara River Area. Sites of the Irkutsk District]. Irkutsk.

**Medvedev, G. I., A. A. Georgiyevsky, G. N. Mikhnyuk, and N. A. Savel'yev**

**1971** Stoyanki Angaro-Bel'skogo raiona [Archaeological Sites of the Angara—Belaya District]. In *Mezolit Yuga Vostochnoy Sibiri*. Irkutsk.

**Medvedev, G. I., G. N. Mikhnyuk, and P. E. Shmigun**

**1975** Mezolit Yuga Vostochnoy Sibiri [The Mesolithic of the Southern Area of Eastern Siberia]. *DINYuVS* III:74–80.

**Medvedev, V. S., and E. N. Nevessky**

**1971** Osnovnye etapy osadkoobrazovaniya v Belom more v chetvertichnoye vremya [Major Stages of Quaternary Sedimentation in the White Sea]. In *Geologiya i litologiya beregovoy zony morey i drugikh krupnykh vodoyemov,* pp. 111–117. Nauka, Moscow.

**Mikhalev, V. M., and E. I. Yeliseyev**

**1992** Arkheologicheskiye issledovaniya v basseyne Verkhney Yany [Archaeological Survey in the Upper Yana River Area]. In *Arkheologicheskiye issledovaniya v Yakutii,* pp. 47–64. Nauka, Novosibirsk.

**Mikkelsen, E.**

**1978** Seasonality and Mesolithic Adaptation in Norway. *New Directions in Scandinavian Archaeology* 1.

**Mochanov, Yu. A.**

**1969** *Mnogosloynaya stoyanka Bel'kachi I i periodizatsiya kamennogo veka Yakutii* [The Belkachi I Stratified Site and Periodization of the Yakutian Stone Age]. Nauka, Moscow.

**1972** Issledovaniya paleolita na Indigirke, Kolyme i zapadnom poberezh'ye Okhotskogo morya [Paleolithic Studies on the Indigirka, Kolyma, and Okhotsk Sea Coast]. *AO* 1971:251.

**1976** Drevneyshiye etapy zaseleniya chelovekom Severo-Vostochnoy Azii [The Oldest Human Occupation of Northeastern Asia]. Avtoreferat dokt. diss., Moscow.

**1977** *Drevneyshiye etapy zaseleniya chelovekom Severo-Vostochnoy Azii* [The Oldest Human Occupation of Northeastern Asia]. Nauka, Novosibirsk.

**Mochanov, Yu. A., and G. M. Savvinova**

**1980** Prirodnaya sreda obitaniya cheloveka v epokhy kamnya i rannikh metallov po materialam arkheologicheskikh pamyatnikov [Natural Environment in the Stone Age and Metal Epoch According to Materials from Archaeological Sites]. In *Novoye v arkheologii Yakutii,* pp. 14–27. Yakutsk.

**Mochanov, Yu. A., and S. A. Fedoseyeva**

**1980** Osnovnye itogi arkheologicheskogo izucheniya Yakutii [Major Results of Archaeological Studies in Yakutia]. In *Novoye v arkheologii Yakutii,* pp. 3–13. Yakutsk.

**Mochanov, Yu. A., S. A. Fedoseyeva, A. N. Alekseyev, and others**

**1983** *Arkheologicheskiye pamyatniki Yakutii. Basseyny Aldana i Olekmy* [Archaeological Sites of Yakutia. The Aldan and Olekma Basins]. Nauka, Novosibirsk.

**Mochanov, Yu. A., S. A. Fedoseyeva, I. V. Konstantinov, N. V. Antipina, and V. G. Argunov**

**1991** *Arkheologicheskiye pamyatniki Yakutii. Basseyny Vilyuya, Anabara i Oleneka* [Archaeological Sites of Yakutia. The Vilyui, Anabar, and Olenek Basins]. Nauka, Novosibirsk.

**Morey, D. F., and M. D. Waint**

**1992** Early Holocene Domestic Dog Burials from the North American Midwest. *Current Anthropology* 33(2):224–229.

**Morlan, R., and R. Bonnichsen**

**1979** Pervonachal'noye zaseleniye chelovekom doliny Old Crow, Ukon [Initial Human Occupation in the Old Crow Valley, Yukon]. In *Drevniye kul'tury Sibiri i Tikhookeanskogo basseyna,* pp. 48–57. Nauka, Novosibirsk.

**Moshinskaya, V. I.**

**1953** Material'naya kul'tura i khozyaistvo Ust'-Poluya [Material Culture and Subsistence Economy of the Ust-Polui Site]. *MIA* 35:72–106.

**1965** Arkheologicheskiye pamyatniki Severa Zapadnoy Sibiri [Archaeological Sites of the West Siberian North]. *SAI*. Vyp. D3-8. Nauka, Moscow.

**Müller-Beck, H. G.**

**1966** Paleohunters in America: Origins and Diffusion. *Science* 152(3726):1191–1210.

**Murygin,** A. M.

**1984** Kheibidya-Pedarskoye zhertvennoye mesto [The Kheibidya-Pedara Sacrificial Site]. Pre-print series *Scientific Reports* 1984:114.

**Nelson, E. W.**

**1899** *The Eskimo about Bering Straight*. 18th Annual Report of the Bureau for American Ethnology. Washington.

**Nikol'skaya, M. V., Z. K. Borisova, F. A. Kaplyanskaya, and others**

**1989** Klimaticheskiye izmeneniya v nekotorykh raionakh Severnoy Azii v pozdnelednikov'ye i golotsene [Climatic Changes in Some Areas of Northern Asia in the Terminal Glaciation and Holocene]. In *Klimaty pozdnelednikovya i golotsena,* pp. 141–145. Nauka, Moscow.

**No author**

**1985** *Atlas Arktiki* [Arctic Atlas]. GUGK, Moscow.

**1987** *Chetvertichnye oledeneniya na territorii SSSR* [Quaternary Glaciation on the Territory of the USSR]. Nauka, Moscow.

**1982** *Paleogeografiya Evropy za posledniye 100.000 let* [Paleogeography of Europe for 100,000 years]. Nauka, Moscow.

**1985** *Severny Ledovity i Yuzhny Okeany* [Polar and Southern Oceans]. Nauka, Leningrad.

**Nordenshold, A. E.**

**1936** *Plavaniye na "Vege"*. Ch. 2 [Voyage of the *Vega*. P. 2]. Glavsevmorput', Leningrad.

**Nummedal, A.**

**1929** *Stone Age Finds in Finmark*. Oslo.

**Okladnikov, A. P.**

**1945** K arkheologicheskomu izucheniyu Sovetskoy Arktiki: itogi i perspektivy [On Archaeological Studies in the Soviet Arctic: Results and Perspectives]. *Problemy Arktiki* Vyp. 2:112–125.

**1946** Arkheologicheskiye issledovaniya 1940–1943 gg v doline r. Leny i drevnyaya istoriya severnykh plemen [Archaeological Survey in the Lena River Valley from 1940 to 1943 and the Ancient History of Northern Tribes]. *KSIIMK* 13:99–107.

**1950a** *Lenskiye drevnosti*. Vyp. 3 [Lena River Relics. Issue 3]. Nauka, Moscow-Leningrad.
**1950b** Neolit i bronzovy vek Pribaikalya [Neolithic and Bronze Age of the Baikal Area]. *MIA* 18.
**1950c** Pervy neolitichesky pamyatnik Chukotskogo poluostrova [The First Neolithic Site on the Chukchi Peninsula]. *KSIIMK* 31:196–198.
**1953** O pervonachal'nom zaselenii vnutrennei chasti Chukotskogo poluostrova [On the Initial Occupation of the Inner Part of the Chukchi Peninsula]. *IVGO* 4:405–412.
**1955** *Istoriya Yakutskoy ASSR*. T. 1 [The History of the Yakutian Autonomous Republic. Vol. 1]. Nauka, Moscow-Leningrad.
**1959** Paleolit Zabaykalya [The Paleolithic of the Trans-Baikal Area]. *Arkheologichesky sbornik BKNII*:5–25.
**1960** Shilkinskaya peschera—pamyatnik drevnei istorii verkhovyev Amura [Shilkinsk Cave—A Site of Ancient History on the Upper Reaches of the Amur River]. *MIA* 86:9–71.
**1970** Neolit Sibiri i Dal'nego Vostoka [Neolithic of Siberia and Soviet Far East]. In *Kamenny vek na territorii SSSR,* pp. 172–193. Nauka, Moscow.
**1975** Neoliticheskiye pamyatniki Sredney Angary [Neolithic Sites in the Middle Angara Area]. Nauka, Novosibirsk.
**1976** *Neoliticheskiye pamyatniki Nizhney Angary* [Neolithic Sites in the Lower Angara Area]. Nauka, Novosibirsk.
**1978** *Verkholensky mogil'nik—pamyatnik drevney istorii narodov Sibiri* [The Verkholensky Burial Ground—Monument of the Ancient Culture of Native Siberians]. Nauka, Novosibirsk.

**Okladnikov, A. P., and N. A. Beregovaya**
**1971** *Drevniye poseleniya Baranova Mysa* [Ancient Dwelling Sites on Cape Baranov]. Nauka, Novosibirsk. [In translation: *The Early Sites of Cape Baranov*. Beringian Shared Heritage Program, National Park Service. Anchorage, Alaska. 2008.]

**Okladnikov, A. P., and I. I. Kirillov**
**1980** *Yugo-Vostochnoye Zabaikal'ye v epokhu kamnya i ranney bronzy* [The Stone and Early Bronze Age in the Southeastern Trans-Baikal Region]. Nauka, Novosibirsk.

**Okladnikov, A. P., and V. V. Naryshkin**
**1955** Novye dannye o drevnikh kul'turakh na Chukotskom poluostrove (drevneye poseleniye na r. Kanchalan]. [New Data on the Ancient Culture of the Chukchi Peninsula (An Old Settlement on the Kanchalan River)]. *SE* 1:151–158.

**Okladnikov, A. P., and I. A. Nekrasov**
**1957** Novye sledy kontinental'noy neoliticheskoy kul'tury na Chukotke (nakhodki u ozera El'gygytgyn) [New Traces of Continental Neolithic Culture in Chukotka (Finds near Lake El'gygytgyn)]. *SA* 2:102–114.

**Okladnikov, A. P., and A. P. Puminov**
**1958** Drevneyshiye sledy cheloveka na r. Olenek [The Most Ancient Evidence of Human Occupation in the Olenek River Basin]. In *Problemy Severa*, Vyp. 1, pp. 352–359. Nauka, Moscow.

**Oshibkina, S. V.**
**1983** *Mezolit basseina Sukhony i Vostochnogo Prionezh'ya* [The Mesolithic of the Sukhona River Basin and Eastern Area of the Onega Region]. Nauka, Moscow.

**Ovchinnikov, M. P.**
**1890** Poyasnitel'naya zapiska k vescham, naidennym u g. Olekminska Yakutskoy oblasti [Comments on the Artifacts Found near Olekminsk Town, Yakut Region]. *Trudy Antropologicheskogo otdela* 12:7–18.

**Peters, B. G.**
**1986** *Kostoreznoiye delo v antichnykh gosudarstvakh Severnogo Prichernomor'yae* [Bone Carving in the Antic Settlements of the Northern Black Sea Area]. Nauka, Moscow.

**Petrin, V. T.**
**1986** *Paleoliticheskiye pamyatniki Zapadno-Sibirskoy ravniny* [Paleolithic Sites of the Western Siberian Plain]. Nauka, Novosibirsk.

**Petrovsky, V. V.**
**1989** *Sosudistye rasteniya o. Vrangelya* [Vascular Plants of Wrangel Island]. Magadan.

**Pesonen, P. E.**
**1978** Mezoliticheskiye pamyatniki Kandalakshskogo berega [Mesolithic Sites of the Kandalaksha Coast]. In *Novye pamyatniki Karelii i Kol'skogo poluostrova,* pp. 94–160. Petrozavodsk.

**Pitul'ko, V. V.**
**1988a** Problemy formirovaniya morskogo promysla u drevnego naseleniya Chukotki [The Problem of the Origination of Sea-Mammal Hunting on the Chukchi Peninsula]. In *Drevneye proizvodstvo, remeslo i torgovlya po arkheologicheskim dannym,* pp. 24–25. Moscow.
**1988b** Novyeye stoyanki s kamennym inventaryom na Krainem Evropeiskom Severo-Vostoke Evropeiskoy chasti SSSR [New Sites with a Stone Inventory in the Far Northeast of the European Part of the USSR]. *KSIA* 193:46–51.
**1989** Otchet o raskopkakh drevnego poseleniya na ostrove Zhokhova v 1989 g. Arkhiv IINK RAN, KP 4359 [Report on Excavations of the Ancient Settlement on Zhokhov Island in 1989. Archive of the Institute for Material Culture History, St. Petersburg].
**1990a** Otchet o raskopkakh Zhokhovskoi stoyanki v 1990 g. Arkhiv IINK RAN, KP 4361 [Report on Excavations of the Ancient Settlement on Zhokhov Island in 1990. Archive of the Institute for Material Culture History, St. Petersburg].
**1990b** Khozyaistvenno-kul'turny tip pozdneneoliticheskogo naseleniya Chukotki [Subsistence Patterns in the Late Neolithic of the Chukchi Peninsula]. In *Drevniye pamyatniki Severa Dal'nego Vostoka,* pp. 74–79. Magadan.
**1991a** Problemy mezolita Severa Sibiri v svyazi issledovaniyami drevnego poseleniya na o. Zhokhova [Problems of the North Siberian Mesolithic (in Connection with Excavations of the Ancient Site on Zhokhov Island)]. In *Problemy istoriko-kul'turnoy sredy Arktiki,* pp. 112–114. Syktyvkar.
**1991b** Na krayu oykumeny kamennogo veka [At the Fringes of the Stone Age Oecumene]. *Priroda* 8:56–59.
**1991c** Drevniye etapy zaseleniya Arktiki: novye dannye [The Ancient Stages of Peopling of the Arctic: New Data]. In *Ancient Cultures and Archaeological Studies,* pp. 6–10. Abstracts of the Annual Conference of the Institute for the Material Culture History. St. Petersburg.
**1991d** Retsenziya: V. S. Stokolos. Drevniye poseleniya Mezenskoy doliny. M., 1986; V. S. Stokolos. Kul'tury epokhi rannego metalla Severnogo priuralya [Review on: V. S. Stokolos. The Ancient Settlements of the Mesen Valley. Moscow, 1986; V. S. Stokolos. Early Metal Cultures of the Northern Ural Area. Moscow, 1988]. *SA* 2:285–291.
**1991e** Problemy perekhodnykh etapov po arkheologicheskim materialam tsircumpolyarnoy zony [Problems of Transitions from the View of Circumpolar Archaeology]. In *Problemy khronologii i periodizatsii v arkheologii,* pp. 12–22. St. Petersburg.
**1991f** Novye stoyanki ortinskoy kul'tury [New Sites of the Ortino Culture]. *KSIA* 203:86–93.
**1991g** The Ancient Settlement of the High Arctic: Some Current Data. In *Specimina Sibirica*. T. V (The Arctic. Papers of the International Conference. Syktyvkar, 16–18 May 1991), pp. 195–202. Savariae.
**1991h** Archaeological Data on the Maritime Cultures of the West Arctic. *Fennoscandia archaeologika* VIII:23–34.
**1992a** K otsenke vozrasta paleoliticheskikh mestonakhozhdeniy Vostochnoy Chukotki [On the Age of the Paleolithic Sites of Eastern Chukotka]. In *Kropotkinskiye chteniya,* pp. 79–82. Chita.
**1992b** The Discovery of a Mesolithic Site in the Polar Region of the Arctic. *Archaeological News* 1:40–51.
**1992c** Mezolit kak ponyatiye arkheologicheskoy periodizatsii [Mesolithic as a Concept in Archaeological Periodization]. In *Problemy paleolita i mezolita Volgo-Uralya,* pp. 32–34. Saratov.
**1992d** Ranniye migratsii v vysokoshirotnoy Arktike [Early Migrations in the High Arctic]. In *Paleoekologiya i rassleniye drevnego cheloveka v Severnoy Azii i Amerike,* pp. 212–215. Krasnoyarsk.
**1992e** Retsensiya: I. I. Krupnik. Arkticheskaya etnoekologiya. M., 1989 [Review of: Igor I. Krupnik. The Arctic Ethno-Ecology. Moscow, Nauka, 1989]. *Russian Archaeology* 4:202–207.
**1993a** Kamennye industrii pozdnego pleistorsena—rannego golotsena Severa Vostochnoy Sibiri [Late Pleistocene and Early Holocene Stone Industries of the East Siberian North]. *PKIKN* 2:43–47.
**1993b** An Early Holocene Site in the Siberian High Arctic. *Arctic Anthropology* 30(1):13–21.
**1993c** Premieres migrations prehistoriques dans L'Arctique [The First Prehistoric Migrations in the Arctic]. *La Recherche* 24(256):898–899.
**1994** Natural Environment of the Arctic and the Problem of Initial Human Occupation. In *Scientific Results of the LAPEX-93 Project,* pp. 360–376. St. Petersburg.
**2001** Holocene Stone Age of North Eastern Asia. In *Encyclopedia of Prehistory, vol.2 (Arctic and Subarctic),* edited by P.N Peregrin and M. Ember, pp. 46–58. Kluwer Academic/Plenum Publishers.
**Pitul'ko, V. V., and A. K. Kasparov**
**1996** Ancient Arctic Hunters: Material Culture and Survival Strategy. *Arctic Anthropology* 33(1).

**Pitul'ko, V. V., and V. M. Makeyev**
**1991** Ancient Arctic Hunters. *Nature* 349(6308):374.
**Pitul'ko, V. V., and V. Ya. Shumkin**
**1993** Ancient Man in the Arctic Ecosystems: Environmental Dynamics and Changeability of Subsistence Models. In *AD POLUS,* pp. 39–46. St. Petersburg.
**Popov, N. I.**
**1878** Ob orudiyakh kamennogo veka na Severe i Vostoke Sibiri [Stone Age Tools in Northern and Eastern Siberia]. *IVSORGO* IX (1, 2):12–17
**Powers, W. R., F. E. Goebel, and N. H. Bigelow**
**1990** Late Pleistocene Occupation at Walker Road: New Data on the Alaskan Nenana Complex. *Current Research in the Pleistocene* 5.
**P'yavchenko, N. I.**
**1952** O peremeschenii rastitel'nykh zon na Severe Vostochnoy Evropy i Zapadnoy Sibiri v poslelednikovoye vremya [Post Glaciation Vegetation Shifts in Northeastern Europe]. *DAN SSSR* 134(1):127–129.
**Puning, Ya. M.-K., and A. V. Raukas**
**1986** *Paleogeografiya pozdnechetvertichnogo vremeni Severnoy Evropy* [Paleogeography of Northern Europe in the Late Quaternary]. VINITI, Moscow.
**Renouf, M. A. P.**
**1984** Northern Coastal Hunter-Fishers and an Archaeological Model. *World Archaeology* 16(1):18–27.
**Reva, K. P.**
**1898** *Sledy doistoricheskogo naseleniya Arkhangel'skoy gubernii* [Evidences of Prehistoric Habitation in the Arkhangel'sk Region]. Arkhangel'sk.
**Rogachev, A. N.**
**1966** Nekotorye voprosy izucheniya epipaleolita Vostochnoy Evropy [Some Questions in Epi-Paleolithic Studies of Eastern Europe]. *MIA* 126:9–13.
**Rudenko, S. I.**
**1947** *Drevnyaya kul'tura Beringova morya i eskimosskaya problema* [Ancient Culture of Bering Sea Region and Eskimo Problem]. Glavsevmorput', Moscow-Leningrad. [In translation: *The Ancient Culture of the Bering Sea and the Eskimo Problem.* Arctic Institute of North America by University of Toronto Press. 1961.]
**Saks, V. N.**
**1948** Chetvertichny period v Sovetskoy Arktike [The Quaternary in the Soviet Arctic]. *Trudy ANII* 201.
**Salvigsen, O.**
**1979** The Last Deglaciation of Svalbard. *Boreas* 8(2):229–231.
**Salvigsen, O., and H. Osterholm**
**1982** Radiocarbon Dated Raised Beaches and Glacial History of the Northern Coast of Spitsbergen, Svalbard. *Polar Research* 1:97–115.
**Sarychev, G. A.**
**1802** *Puteshestviye flota kapitana Sarycheva po severo-vostochnoy chasti Sibiri, Ledovitomu moryu i Vostochnomu okeanu v prodolzhenii os'mi let pri geograficheskoy i astronomicheskoy morskoy ekspeditsii, byvshey pod nachalom kapitana Billingsa s 1785 po 1793 god.* Ch. 1 [Captain Sarychev's Journey along the Northeastern Part of Siberia, Arctic Ocean, and Pacific Ocean during Eight Years with the Geographic and Astronomical Naval Expedition Headed by Captain Billings from 1785 to 1793. Part 1]. St. Petersburg.
**Savel'yev, N. A., O. Yu. Goryunova, and A. G. Generalov**
**1980** Raskopki mnogosloynoy stoyanki Gorely Les [Excavations at the Gorely Les Stratified Site]. *DINYuVS* 4:160–175.
**Savvinova, G. M.**
**1992** Razvitiye rastitel'nosti v pleistotsen-golotsenovoye vremya Yakutii po materialam arkheologicheskikh stoyanok [Development of Vegetation during the Pleistocene and Holocene as Shown from the Data Obtained at Archaeological Sites]. In *Arkheologicheskiye issledovaniya v Yakutii,* pp. 190–192. Nauka, Novosibirsk.
**Scherbakova, N. M.**
**1980** Arkheologicheskiye pamyatniki Yany [Archaeological Sites on the Yana River]. In *Novoye v arkheologii Yakutii,* pp. 62–65. Yakutsk.
**Serebryannaya, T. A.**
**1972** Paleofitologicheskaya kharakteristika lessov iz razreza bliz poselka Karachizh v raione g. Bryanska [Phy-

topaleontology of Loess Sediments from the Karachizh Section, Bryansk Region]. In *Palinologiya pleistotsena,* pp. 55–72. Nauka, Moscow.

**Serebryannaya, T. A., and E. O. Il'ves**

**1974** Palinologicheskiye materialy po razrezam verkhney Oki [Palynology of the Upper Oka Cross Sections]. *BKIChP* 42:23–35.

**Serebryanny, L. R.**

**1974** Migratsiya yeli na severe i vostoke Evropy v pozdne- i poslelednikovoye vremya [Spruce Migration in Northern and Eastern Europe in the Terminal and Post-Glacial Time]. *BKIChP* 41:56–67.

**Serikov, Yu. B., and I. E. Kuzmina**

**1985** Mezoliticheskaya Koksharovsko-Yur'evskaya stoyanka v Srednem Zaural'ye [The Mesolithic Koksharovsko-Yur'evskaya Site in the Middle Trans-Ural Area]. *Trudy ZIN* 131:89–92.

**Shmidt, A. V.**

**1930** Drevny mogil'nik na Kol'skom zalive [Old Burial Ground on Kola Bay]. *Kol'sky Sbornik*, Vyp. 23, pp. 119–169. Leningrad.

**Shmigun, P. E., and A. K. Filippov**

**1982** Nizhny kompleks stoyanki Kurla [Lower Complex from the Kurla Site]. In *Material'naya kul'tura drevnego naseleniya Vostochnoy Sibiri,* pp. 15–24. Irkutsk.

**Shtukenberg, A. I.**

**1875** *Otchet geologicheskogo puteshestviya v Pechorsky kray i Timanskuyu tundru* [Report on a Geological Survey in the Pechora Region and Timan Tundra]. St. Petersburg.

**Shumkin, V. Ya.**

**1984** Kamennaya i kostyanay industriya mezolita i rannego metalla Kol'skogo poluostrova [Stone and Bone Industry of Kola Peninsula Sites from the Mesolithic to the Early Metal Period]. Avtoreferat kand. diss., Leningrad.

**1988a** K voprosu o formirovanii khozyaistvenno-kul'turnykh tipov u drevnego naseleniya Kol'skogo poluostrova [On the Question of the Formation of Subsistence Patterns of the Kola Peninsula Natives]. *KSIA* 193:9–14.

**1988b** Mezolit Kol'skogo poluostrova [The Mesolithic of the Kola Peninsula]. *SA* 4:15–33.

**1990** Vliyaniye prirodno-ekologicheskogo faktora na zaseleniye Arkticheskikh raionov Severo-Zapada Evropy [Natural Environment Affecting Human Occupation of Arctic Areas of Northwestern Europe]. In *Problemy istoriko-kul'turnoy sredy Arktiki,* pp. 12–49. Moscow.

**Shyutt, B., G. Hoppe, V. Bleik, and M. Grosswald**

**1974** O rasprostranenii pozdnepleistotsenovogo oledeneniya v Evropeiskoy Arktike [The Range of Late Pleistocene Glaciation in the European Arctic]. *Izvestiya AN SSSR* Geographic series 5.

**Simchenko, Yu. B.**

**1976** *Kul'tura okhotnikov na oleney Severnoy Evrasii* [The Culture of Reindeer Hunters of Northern Eurasia. An Ethnographical Reconstruction.]. Nauka, Moscow.

**Sisko, R. K.**

**1970** Novosibirsky arkhipelag [The New Siberian Archipelago]. In *Sovetskaya Arktika. Morya i ostrova,* pp. 422–453. Nauka, Moscow.

**Slobodin, S. B.**

**1999** *Archaeology of Kolyma and Continental Priokhotye in the Late Pleistocene and Holocene.* SVKNII DVO RAN, Magadan.

**Slobodin, S. B., and O. Yu. Glushkova**

**1992** Stoyanka Kheta—pervy stratifitsirovanny pamyatnik na Kolyme [Kheta—The First Stratified Archaeological Site in the Kolyma Region]. In *Paleoecologiya i rasseleniye drevnego cheloveka v Severnoy Azii i Amerike,* pp. 225–228. Krasnoyarsk.

**Stanford, D. J.**

**1976** The Walakpa Site, Alaska. *Smithsonian Contributions to Anthropology.* Vol. 20. Smithsonian Institution Press, Washington.

**Starkov, V. F.**

**1991** Issledovaniya russkikh pamyatnikov perioda pozdnego srednevekovya i novogo vremeni na territorii Arktiki [Research on Russian Sites of the Late Middle Age and Recent Time in the Arctic]. *KSIA* 200:17–21.

**Stokolos, V. S.**

**1986** *Drevniye poseleniya Mezenskoy doliny* [Ancient Sites in the Mezen River Valley]. Nauka, Moscow.

**1988** *Kul'tury epokhi rannego metalla Severnogo priural'ya* [Cultures of the Early Metal Period in the Northern Ural Region]. Nauka, Moscow.

**Strelkov, S. A.**

**1968** Tsentry oledeneniy na Severe Sibiri, usloviya i stadii ikh razvitiya [Centers of Glaciation in the Siberian North: Conditions and Stages]. In *Neogenovye i chetvertichnye otlozheniya Zapadnoy Sibiri,* pp. 88–98. Nauka, Moscow.

**Syroeychkovsky, E. E.**

**1986** *Severny olen'* [Reindeer]. Agropromizdat, Moscow.

**Talbitzer, W.**

**1924** Parallels within the Culture of Arctic Peoples. *Annales do XX Congresso de Americanistas*. Rio de Janeiro.

**Tein, T. S.**

**1979** Arkheologicheskiye issledovaniya na ostrove Vrangelya [Archaeological Survey on Wrangel Island]. In *Novye arkheologicheskiye pamyatniki Severa Dal'nego Vostoka,* pp. 53–63. Magadan.

**Toll', E. V.**

**1899** Ocherk geologii Novosibirskikh ostrovov i vazhneyshiye zadachi izucheniya polyarnykh stran [Geological Sketch of the New Siberian Islands and the Most Important Tasks of Polar Research]. *Zapiski Akademii Nauk* VIII.

**Tomirdiaro, S. V.**

**1972** *Vechnaya merzlota i osvoyeniye gornykh stran i nizmennostey* [Permafrost and Developing of Mountain Areas and Lowlands]. Magadan.

**Tomskaya, A. I.**

**1989** Klimat pozdnelednikov'ya i golocena Yakutii (po palinologicheskim dannym) [Climatic Conditions of the Yakut District in the Late Glacial Age and the Holocene (According to Pollen Core Analysis)]. In *Klimaty pozdnelednikov'ya i golocena,* pp. 109–116. Nauka, Moscow.

**Tomskaya, A. I., and G. M. Savvinova**

**1970** Palinologicheskaya kharakteristika otlozheniy mnogosloynoy stoyanki Bel'kachi I [Palynological Characteristics of the Belkachi I Stratified Site]. In *Po sledam drevnikh kul'tur Yakutii,* pp. 32, 33. Yakutsk.

**Troitsky, L., J. M.-K. Punning, G. Hutt, and R. Ragamae**

**1979** Pleistocene Chronology of Spitzbergen. *Boreas* 8(4):401–407.

**Tugarinov, A. Ya.**

**1929** O proiskhozhdenii Arkticheskoy fauny Evrazii [About the Origin of Eurasian Arctic Fauna]. *Priroda* 7–8:17–39.

**1934** Opyt istorii Arkticheskoy fauny Evrazii [History of Eurasian Arctic Fauna]. *Trudy AIChPE* 5:55–65.

**Ukraintseva, V. V.**

**1982** Prirodnaya sreda i usloviya gibeli mamonta v verkhnem techenii r. Yuribei (Gydansky poluostrov) [Natural Environment and Conditions of the Death of a Mammoth on the Upper Reaches of the Yuribei River, Gydan Peninsula]. In *Yuribeysky mamont,* pp. 19–30. Nauka, Moscow.

**Uvarov, A. S.**

**1881** *Arkheologiya Rossii. Kamenny period.* T. 1 [Russian Archaeology. Stone Age. Vol. 1]. Moscow.

**Vakorin, A. A., and A. I. Kuptsova**

**1975** Pozdnelednikovy bassein v Verkhneponoiskoi nizmennosti [Late Glacial Basin in the Upper Ponoi Depression]. In *Istoriya ozer v golotsene,* pp. 68–73. Tom 1. Leningrad.

**Van Linskhotten, Ya. G.**

**1915** Niderlandskiye ekspeditsii k severnym beregam Rossii v 1594–1595 gg [Dutch Expeditions to the Russian North Coastal Areas in 1594–1595]. *Zapiski po gidrografii* XXXIX:417–439.

**Vartanyan, S. L., V. E. Garutt, and A. V. Sher**

**1993** Holocene Dwarf Mammoths from Wrangel Island in the Siberian Arctic. *Nature* 362(6418):337–340.

**Vasilyev, S. A., and N. M. Ermolova**

**1983** Maininskaya stoyanka—novy pamyatnik paleolita Sibiri [The Maina Site—A New Paleolithic Monument in Siberia]. In *Paleolit Sibiri. Novosibirsk,* pp. 67–75. Nauka.

**Vasilyevsky, R. S., and V. A. Golubev**

**1976** *Susuiskaiya stoyanka* [The Susui Site]. Nauka, Novosibirsk.

**Velicko, A. A.**

**1973** *Prirodny protsess v pleistotsene* [The Pleistocene Environmental Trend]. Nauka, Moscow.

**1979** Problemy rekonstruktsii pozdnepleistotsenovykh oledeneniy i lednikovykh pokrovov na territorii SSSR [Problems of the Reconstruction of Late Pleistocene Glaciation and Ice Cover in the Territory of the USSR]. *Izvestiya AN SSSR*, Geographic series 6:12–26.

**Velicko, A. A., and M. A. Faustova**

**1982** Problema obosnovaniya maksimal'noi granitsy pozdnepleistotsenovogo oledeneniya na Severe Evrazii [The Problem of the Basis of the Maximal Range of Late Pleistocene Glaciation in Northern Eurasia]. In *Razvitiye prirody territorii SSSR v pozdnem pleistotsene i golotsene,* pp. 7–16. Nauka, Moscow.

**1987** Vostochno-Evropeiskiy region [The East European Region]. In *Chetvertichnoye oledeneniye territorii SSSR,* pp. 14–42. Nauka, Moscow.

**Velicko, A. A., M. A. Faustova, and L. L. Isayeva**

**1988** Paleogeograficheskiye reconstruktsii poslednego oledeneniya v Severnom Polusharii [Paleogeographic Reconstructions of Last Glaciation in the Northern Hemisphere]. In *Chetvertichnaya Paleoecologiya i paleogeographiya Severnykh Morei,* pp. 27–43. Nauka, Moscow.

**Vereschagin, N. K.**

**1969** Proiskhozhdeniye i evolutsiya belogo medvedya [Origin and Evolution of the Polar Bear]. In *Bely medved'i yego okhrana v Sovetskoi Arktike,* pp. 25–53. Nauka, Leningrad.

**1971** Ostatki zhivotnykh iz zhilisch Baranova Mysa [Faunal Remains from the Cape Baranov Dwelling Site]. Appendix to: Okladnikov, A. P. and N. A. Beregovaya. *Drevniye poseleniya Baranova Mysa,* pp. 149–156. Nauka, Novosibirsk.

**1973** Kraniologicheskaya kharakteristika sovremennykh i iskopaemykh medvedei [Craniology of Contemporary and Fossil Polar Bears]. *Zoological Magazine* 52(6):920–930.

**Vereschagin, N. K., and Yu. A. Mochanov**

**1972** Samye severnye v mire sledy verkhnego paleolita (mestonakhozhdeniye Berelekh v nizov'yakh Indigirki) [The Northernmost Evidence of Paleolithic Occupation: The Berelekh Site on the Lower Reaches of the Indigirka River]. *SA* 3:332–336.

**Vereschagin, N. K., and A. N. Tikhonov**

**1991** Istoriya arealov medvedei fauny SSSR [Area History of Bear Fauna in the USSR]. In *Medvedi v SSSR,* pp. 5–9. Nauka, Novosibirsk.

**Vereschagin, N. K., and V. V. Ukraintseva**

**1985** Proiskhozhdeniye i stratigrafiya Berelekhskogo "kladbischa" mamontov [Origin and Stratigraphy of the Berelekh Mammoth Graveyard]. *Trudy ZIN* 131:104–113.

**Vereschagina, I. V.**

**1973** Pamyatniki s mikroliticheskim inventarem Bolshezemel'skoi tundry [Archaeological Sites with Microlithic Inventory in the Bolshezemel'skaya Tundra]. *MAESV* 5:3–21.

**1979** Mesolit i neolit Krainego Evropeiskogo Severo-Vostoka [The Mesolithic and Neolithic of the Extreme European Northeast]. Avtoreferat kand. diss., Leningrad.

**1991** Mezolit na Krainem Evropeiskom Severo-Vostoke [The Mesolithic of the Extreme European Northeast]. *KSIA* 200:48–52.

**Verkulich, S. R., A. G. Krusanov, and M. A. Anisimov**

**1990** Sovremennoye sostoyaniye i tendentsii oledeneniya o. Bennetta za posledniye 40 let [The Current State and Trends of Glaciation on Ostrov Bennetta for the Past 40 Years]. *Materialy Glaciologicheskikh issledovaniy* 70:111–115.

**Verkulich, S. R., V. M. Makeyev, Kh. A. Arslanov, D. P. Ponomareva, T. V. Tertychnaya, and O. F. Baranovskaya**

**1989** Stroyeniye i geokhronologiya chetvertichnykh otlozhenii ostrova Bennetta [Structure and Geochronology of Quaternary Deposits on Ostrov Bennetta]. In *Geokhronologiya chetvertichnogo perioda,* pp. 16–17. Tallinn.

**Vetrov, V. M.**

**1982** Arkheologicheskiye issledovaniya v Muiskoi kotlovine (1976–1978) [Archaeological Survey of the Muya Depression from 1976 to 1978]. In *Material'naya kul'tura drevnego naseleniya Vostochnoi Sibiri,* pp. 86–100. Irkutsk.

**Vishnyatsky, L. B.**

**1987** Kostyanye izdeliya s pazami iz pozdnepaleoliticheskoi stoyanki Berezovy Ruchei [Grooved Bone Tools Found in the Late Paleolithic Berezovy Ruchei Site]. *SA* 3:202–203.

**1989** Review of: Zvelebil M. (Ed.). Hunters in Transition. Mesolithic Societies of Temperate Eurasia and Their Transition to Farming. Cambridge Univ. Press, 1986. *SA* 4:277–284.

**Vishnyatsky, L. B., and E. M. Kolpakov**

**1991** Periodizatsiya v arkheologii [Periodization in Archaeology]. In *Problemy khronologii i periodizatsii v arkheologii,* pp. 5–11. Leningrad.

**Volokitin, A. S.**

**1986** New Data on the Mesolithic of the European Northeast of the USSR]. *MAESV* 10:22–34.

**Volokitin, A. S., and L. A. Konovalenko**

**1988** Novy mezolitichesky pamyatnik Parch III na Vychegde [The New Mesolithic Parch III Site in the Vychegda River Area]. *MAESV* 11:19–32.

**Vorobei, I. E.**

**1992** Druchak-B—novaya dokeramicheskaya stoyanka v Severnom Priokhot'ye [Druchak-B—A New Site of the Preceramic Period in the Northern Okhotsk Sea Region]. In *Paleoekologiya i rasseleniye drevnego cheloveka v severnoi Azii i Amerike,* pp. 43–45. Krasnoyarsk.

**Voronov, P. S.**

**1968** *Ocherki o zakonomernostyakh morfometriiglobal'nogo reliefa Zenli* [Notes on the Natural Development of Global Relief Morphometry of the Earth]. Nauka, Leningrad.

**Voyevodsky, M. V.**

**1950** Mezoliticheskiye kultury Vostochnoi Evropy [Mesolithic Cultures of Eastern Europe]. *KSIIMK* 31:96–119.

**Washburn, A. L.**

**1958** *Klassifikatsiya strukturnykh gruntov i obzor teoriy ikh proiskhozhdeniya* [Classification of Structured Soils and a Review of the Theories of Their Origin]. In *Merzlye porody Alaski i Kanady,* pp. 106–154. Izdatel'stvo Inostrannoy Literatury, Moscow.

**Welinder, S.**

**1983** Ecosystems at the Neolithic Transition. *NAR* 16:106–122.

**West, F. H.**

**1976** Archaeologicheskiy complex Tangl-Leiks, Tsentral'naya Alaska, i ego svyazi so Starym Svetom [The Tangle Lakes Archaeological Complex, Central Alaska, and Its Connections with the Old World]. In *Beringia v Kainozoye,* pp. 439–458. Vladivostok.

**Zemlyakov, B. F.**

**1937** Arcticheskiy paleolit na severe SSSR [The Arctic Paleolithic on the North of the USSR]. *Trudy KIChP* 5(1):69–87.

**1940** Arcticheskiy paleolit na severe SSSR [The Arctic Paleolithic on the North of the USSR]. *SA* 5:107–143.

**Zenger, N. K.**

**1877** *Poezdka na Zolotitskuyu fabriku doistoricheskikh kamennykh orudiy v Arkhangel'skoi gubernii* [A Visit to the Zolotitsa Stone Tool Workshop in the Arkhangel'sk Region]. Moscow.

**Zhuravsky, A. V.**

**1909** Resul'taty issledovaniy Pripolyarnogo Zapechorya v 1907 i 1908 gg [Results of a Survey in the Pechora Trans-Polar Area in 1907–1908]. *IRGO* XIX:207–209.

**Zubakov, V. A.**

**1972** *Paleogeographiya Zapadno-Sibirskoi nizmennosti v pozdnem pleistotsene i golotsene* [Paleogeography of the West Siberian Lowland in the Late Pleistocene and Holocene]. Nauka, Leningrad.

# FIGURES

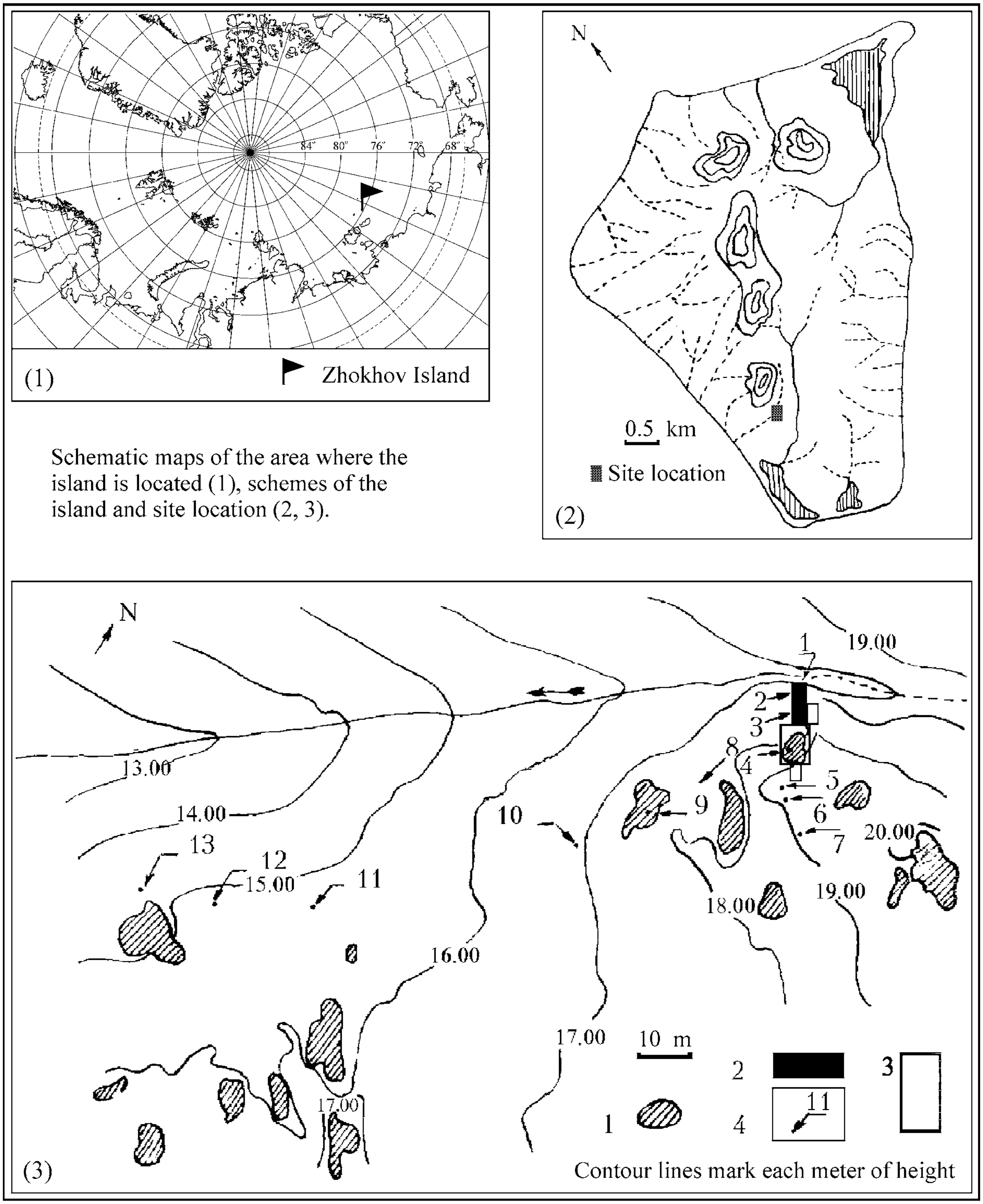


**Figure 1. Scheme of area surveyed (1, 2) and map of the site location on Zhokhov Island (3).**

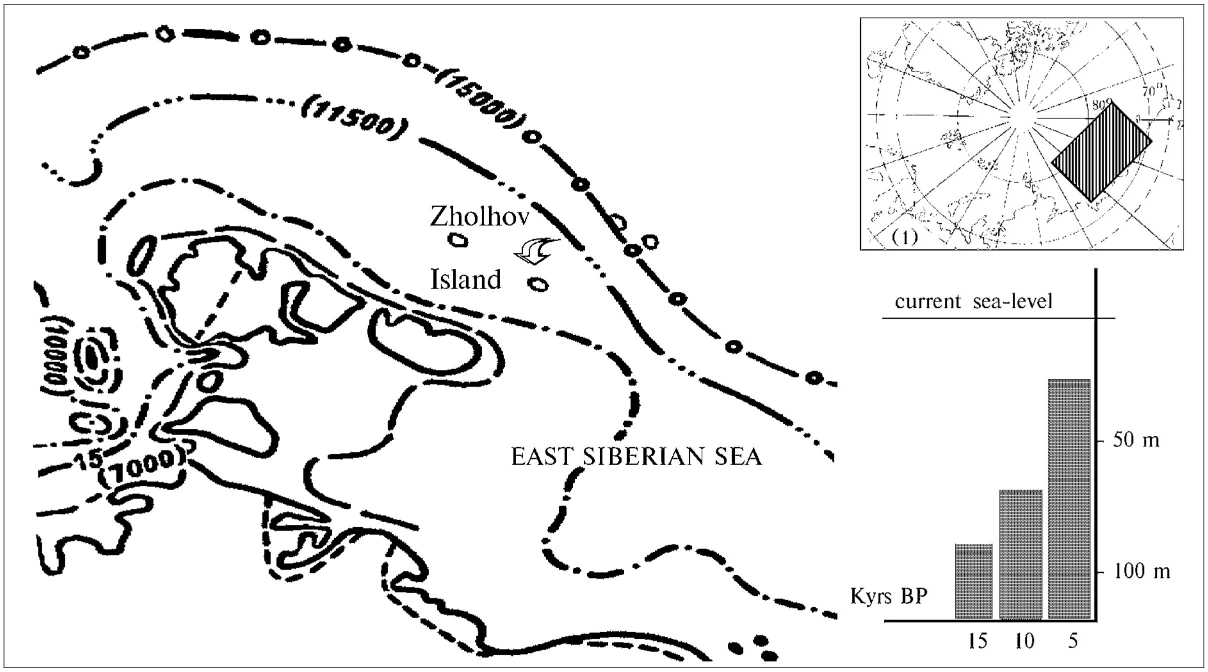


**Figure 2. Schematic map of the New Siberian Islands with the Late Pleistocene and Holocene coast lines (15,000, 11,500, and 7000 BP respectively), after Yu. P. Degtyarenko, M. G. Blagoveschensky, and A. P. Puminov (1982), and relative diagram showing transgression dynamics.**

**Figure 3. Zhokhov Island site. South view.**

**Figure 4. The surface near Dwelling 10 (Fig 1). One can observe a rounded accumulation formed by wooden pieces and bone fragments that were pushed to the surface by cryogenic processes. The slope of a thermokarst depression at Accumulation 9 is seen in the left background. View from the SW.**

**Figure 5. View from the east to the west slope (along Line 7 of the excavation grid) of the thermokarst depression in the center of the excavated area (Figs. 11, 16).**

**Figure 6. View from the west to the east slope (along Line 9 of the excavation grid) of the thermokarst depression in the center of the excavated area (Figs. 11, 16).**

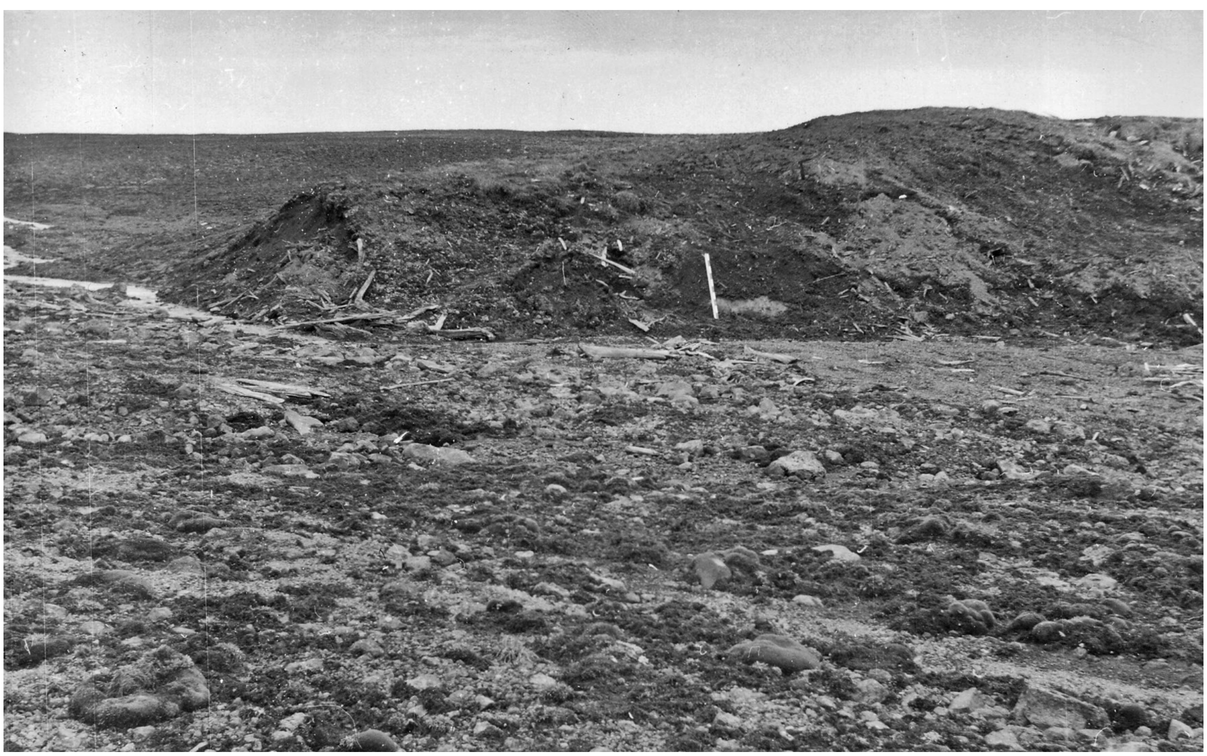

**Figure 7. The most elevated part of the site area—the "cape" jutting out into the stream valley (see Fig 1:3), where the excavations were carried out in 1989–1990. View from the west side.**

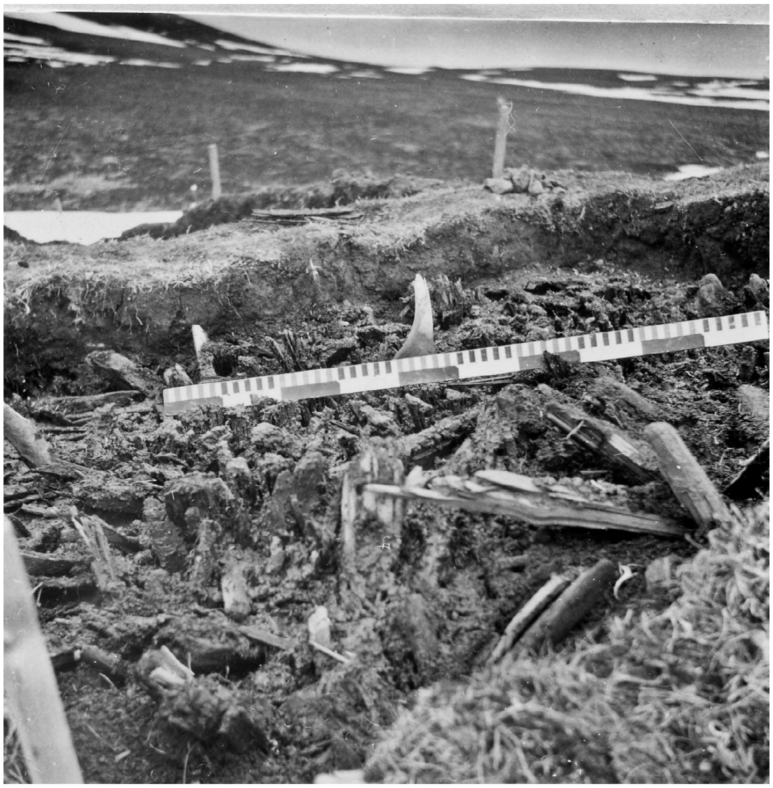

**Figure 8. Surface of the cultural layer in melting (Square 23). View from the south.**

**Figure 9. The eastern part of the excavation area (1990 field season)—Square 53, where the cultural layer appeared to be moved down because of solifluction; a surface of thick ice interbed discovered in Squares 53 and 54 is suggested to be a slickenside. Isolated flints, bone fragments, and pieces of wood were found that were thought to be redeposited together with the layer (Figs. 16, 17). View from the west side.**

Figure 10. Square 24 during excavation. This square, as well as adjacent ones, had the most favorable conditions for excavation, being well drained naturally due to a slight sloping of the surface. South view.

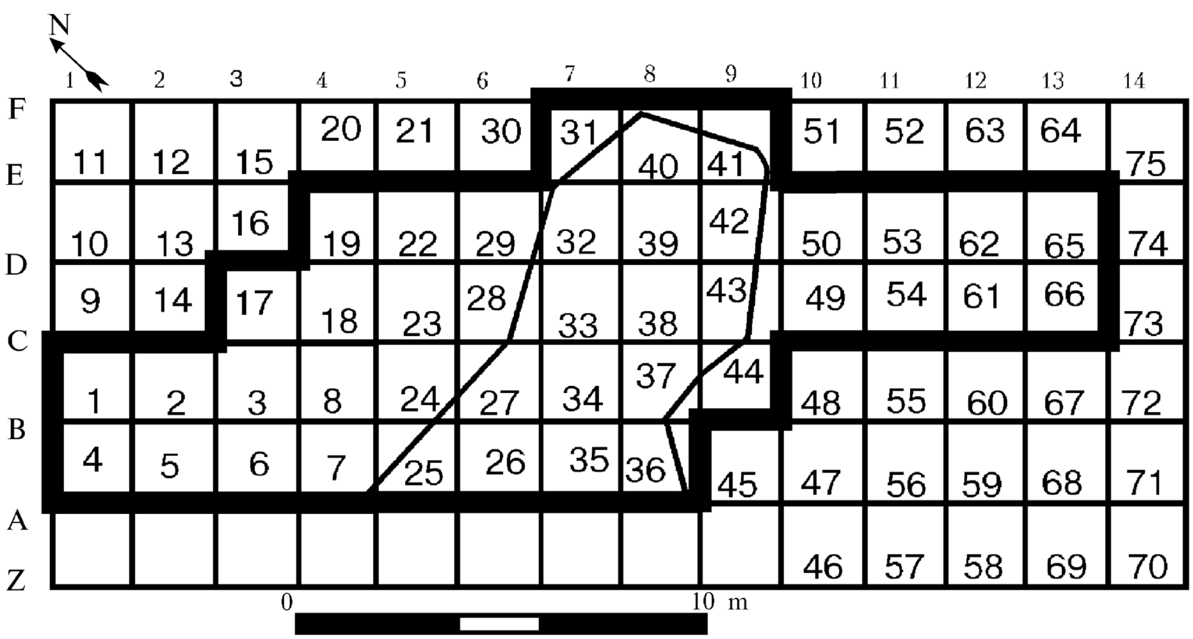


Figure 11. General schema of the area excavated in 1989–1990.

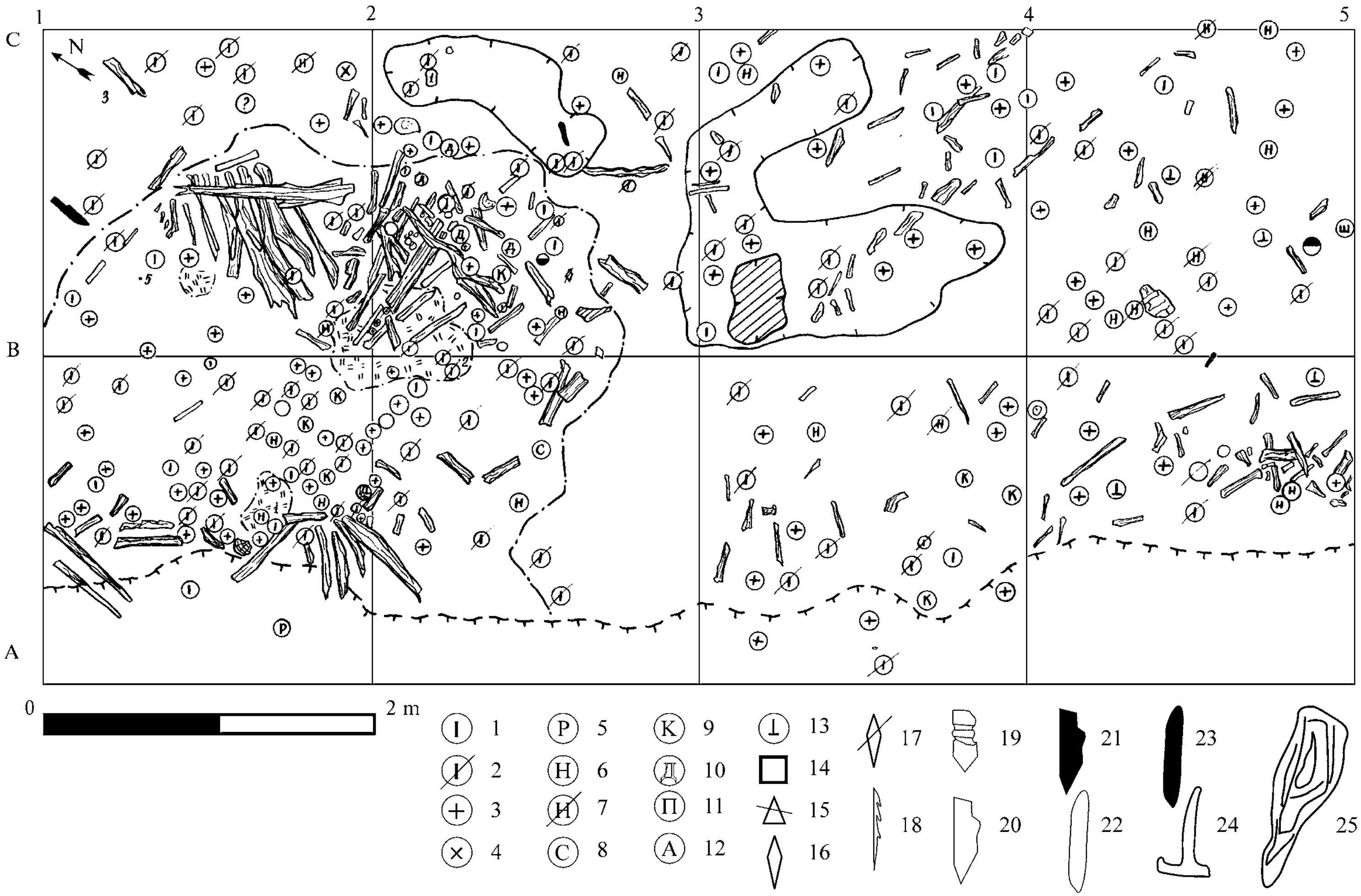


**Figure 12. Map of the area excavated in 1989 (Squares 1–8). Legend: (1) microblade or bladelet; (2) fragmented microblade or bladelet; (3) flakes; (4) chips; (5) cores; (6) fragmented cores; (7) manufactured wooden pieces; (8) manufactured bone fragment; (9) human tooth (?); (10) large wooden pieces; (11) pit; (12) border of the spot saturated with charcoal; (13) area saturated with charcoal and broken bones; (14) a border of talus; (15) arrow head; (16) a fragment of a point; (17) antler pick-axe; (18) wooden scoop; (19) ridged blades; (20) a large piece of flaking surface knapped off a core; (21) tablette flakes; (22) large flint debris; (23) scraper (?); (24) primitive greenstone side scraper (?); (25) flint insets; (26) volcanic silicious slag; (27) bone or antler tools; (28) organic material sampled for carbon-14 dating; (29) pebble used as a hammerstone.**

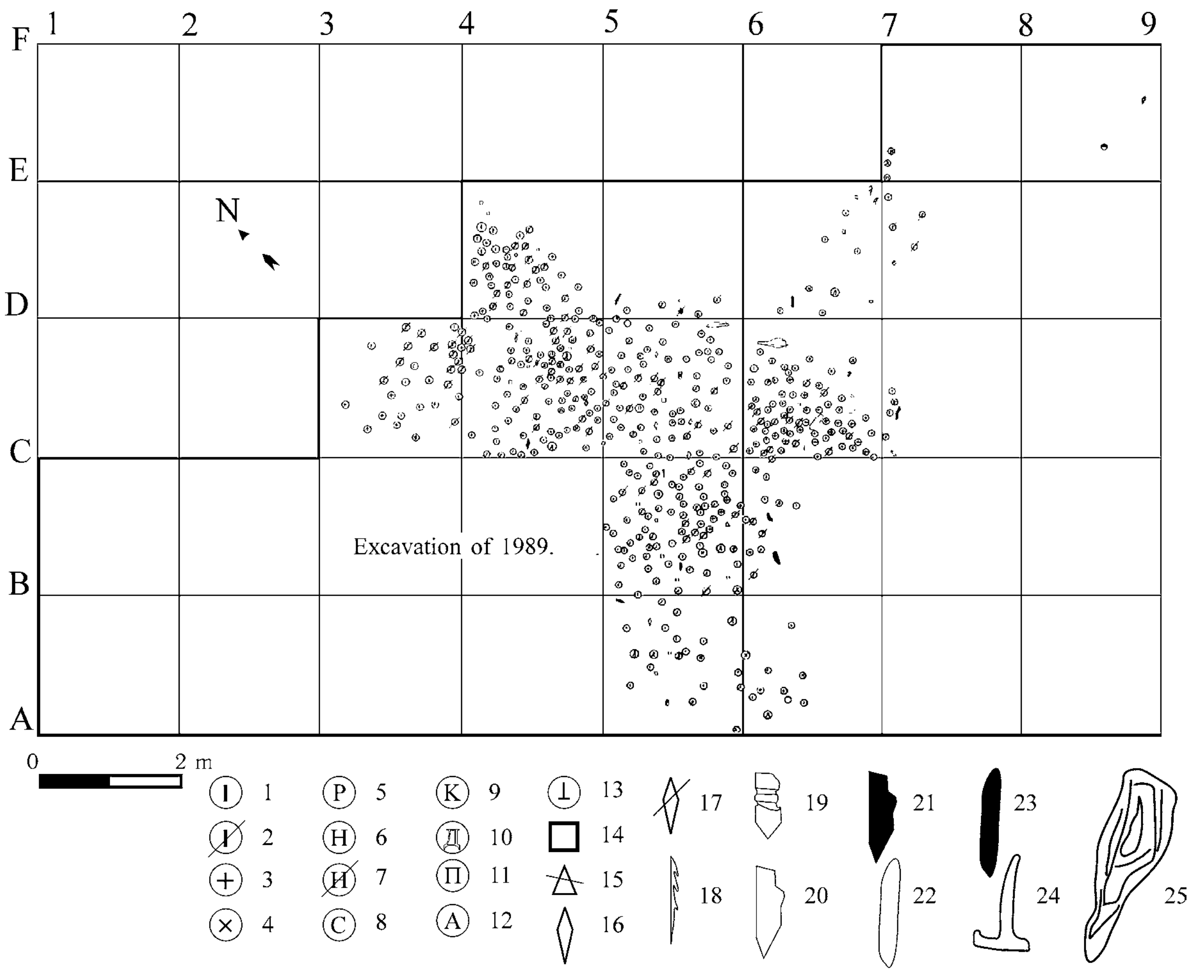


**Figure 13. Map of the area excavated in 1990 showing artifacts and the dig of 1989. West section. Legend: 1 – microblades; 2 – fragmented microblades; 3 – flint flakes; 4 – mammoth ivory flakes; 5 – ridged blades; 6 – cores; 7 – fragmented cores; 8 – large flakes; 9 – bone artifacts; 10 – fragmented arrow shafts; 11 – pumice stones; 12 – grinding stones; 13 – T-shaped antler handles; 14 – pieces of a stone raw material; 15 – fragments of stone axes; 16 – bone points of small size (out of scale); 17 – fragmented bone points of small size (out of scale); 18 - «harpoon»; 19 – pickaxes of mammoth ivory; 20 and 21 – pickaxes of antler; 22 and 23 – large performs of inset tools or non-bladed points; 24 – antler handles for axes or chisels (?); 25 – wooden home utensils; 26 – sled runner. Note: Items marked # 19 – 26 are shown in scale.**

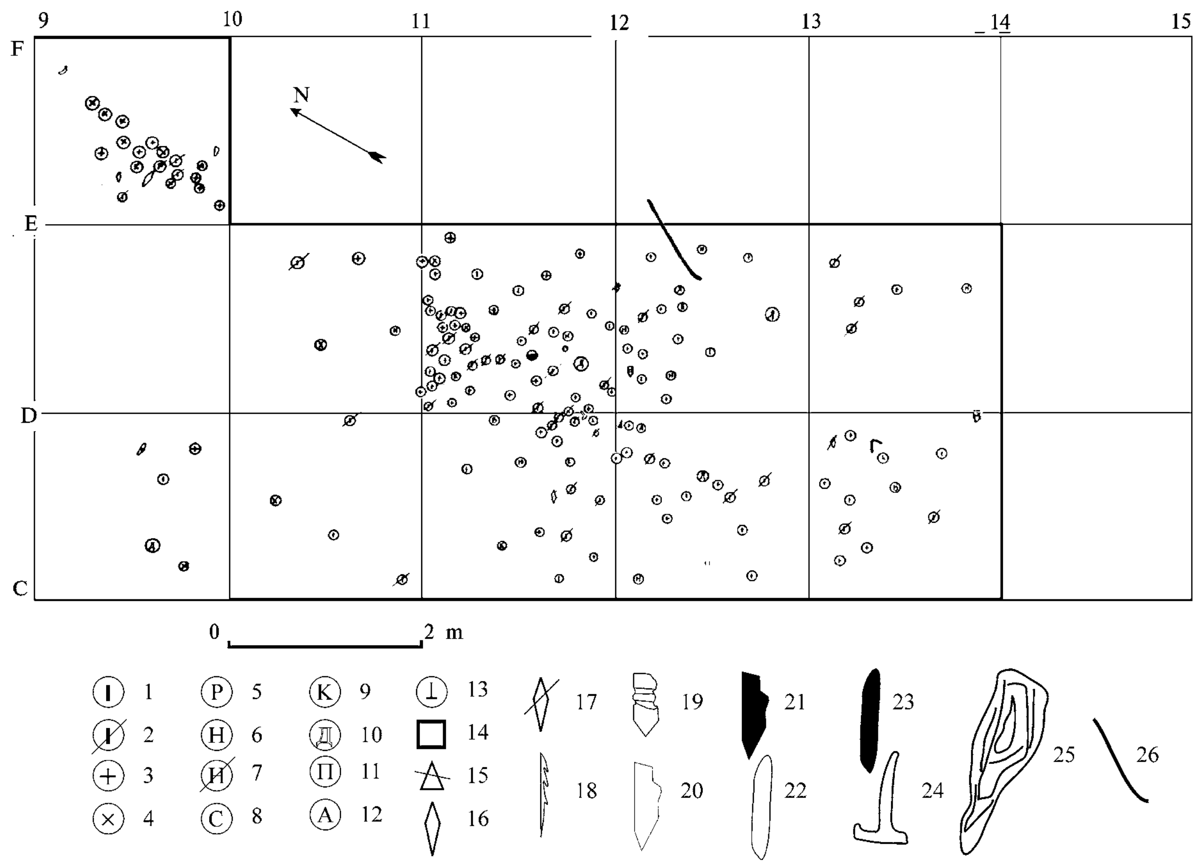


**Figure 14. Map of the area excavated in 1990 showing artifacts. Legend of excavation map (Figs. 13, 14): (1) microblades or bladelets; (2) fragmented microblades or bladelets; (3) flint flakes; (4) mammoth ivory flakes; (5) ridged blades; (6) cores; (7) fragmented cores; (8) large flakes; (9) bone artifacts; (10) fragmented arrowshafts; (11) pumice stones; (12) grinding stones; (13) T-shaped antler handles; (14) pieces of a stone raw material; (15) fragments of stone axes; (16) small bone points (not to scale); (17) small fragmented bone points (not to scale); (18) "harpoon"; (19) pickaxes of mammoth ivory; (20, 21) pickaxes of antler; (22, 23) large preforms of inset tools or non-bladed points; (24) antler handles for axes or chisels (?); (25) wooden domestic utensils; (26) sledge runner. Note: Items marked 19–26 are shown in scale. East section.**

**Figure 15. Excavations in solimixture with cultural remains in Square 33 (Line 7 of the excavation grid, the west slope of the thermokarst depression dissecting the dig area into west and east parts). A view from the south. A lot of split driftwood had been turned up almost vertically by permafost. One of the wooden domestic utensils was discovered in the same position (Figs. 55, 56).**

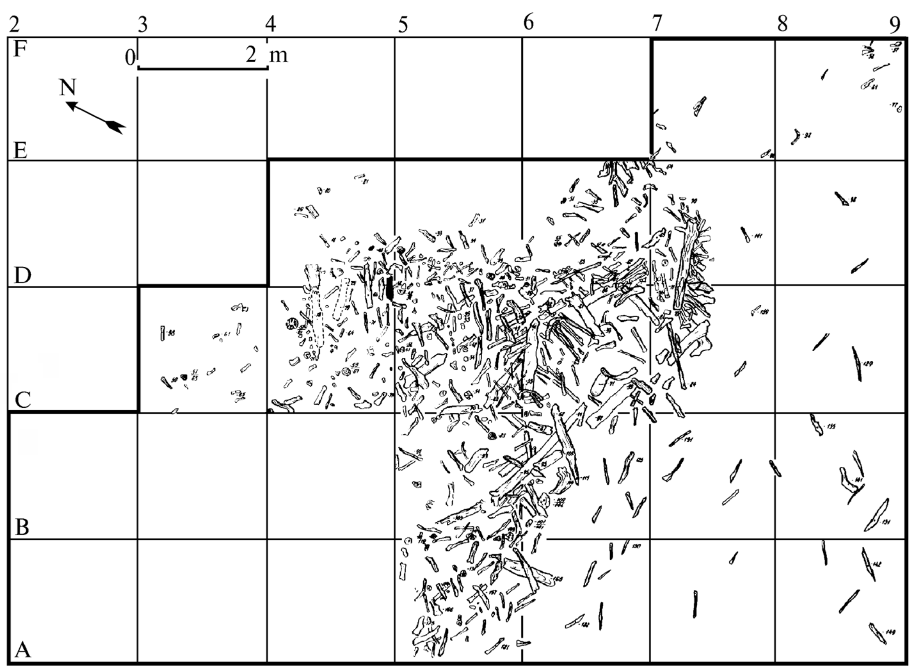


**Figure 16. Map of the area excavated in 1990 showing wooden pieces and the dig of 1989. West section.**

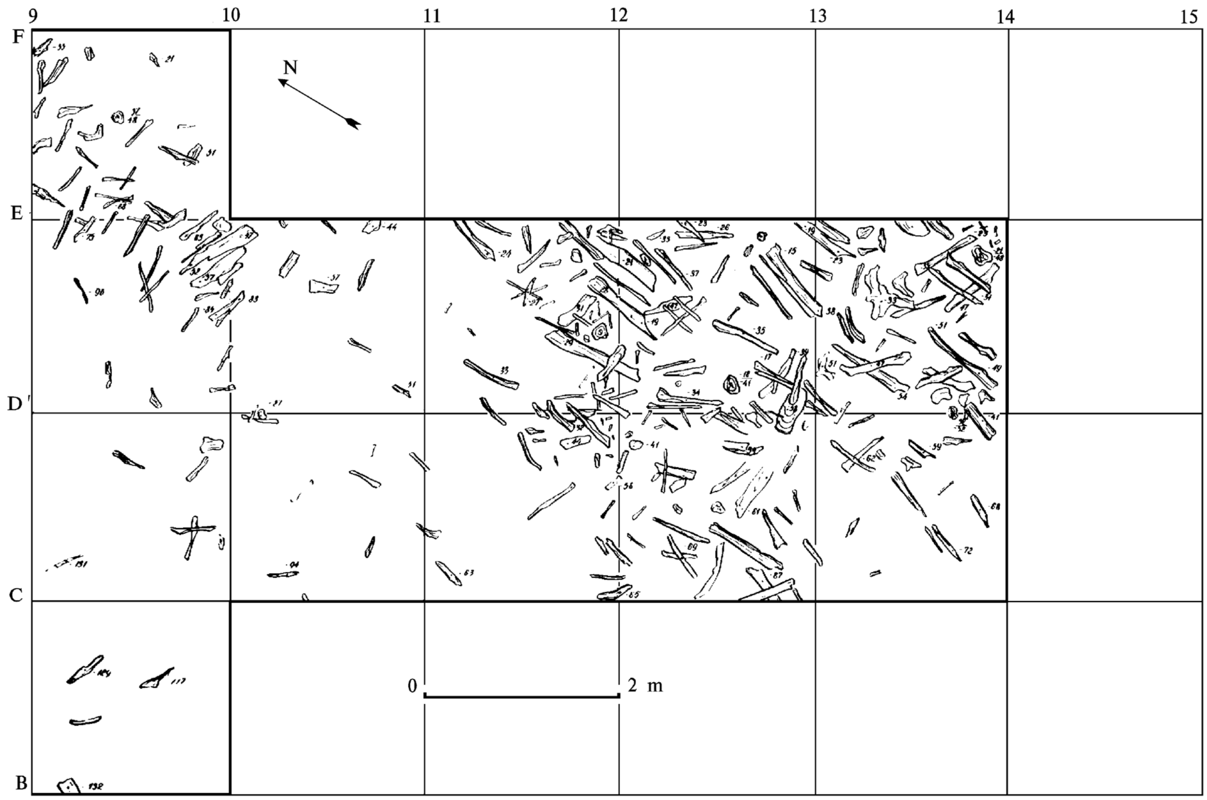


**Figure 17. Map of the area excavated in 1990 showing wooden pieces. East section.**

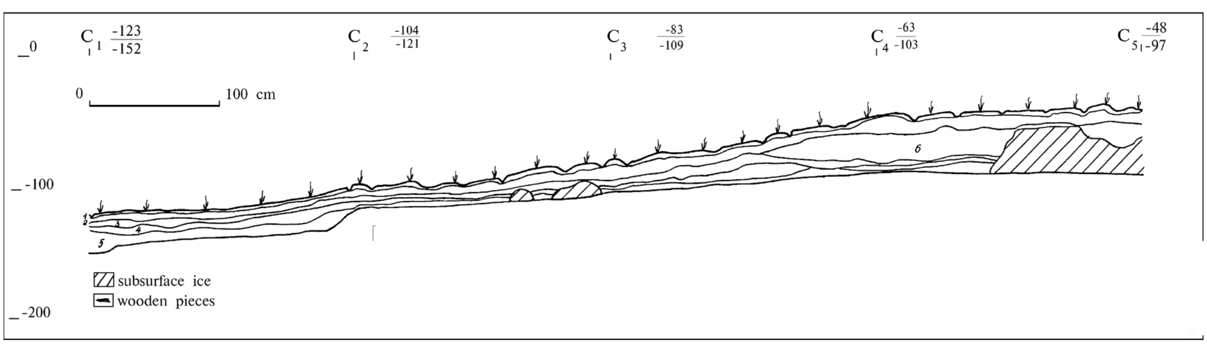


**Figure 18. Profile B1–B5. Legend: 1 – turf; 2 – grey-brown loamy soil; 3 – bright-brown loamy soil (cultural layer); 4 – channel sediments; 5 – blue-grey hard loamy soil; 6 – peat-bog sediments which were deposited in the Holocene in thermokarst lake disturbed in upper part of the cultural layer; peat sampled from the mid-level had been dated to 2200 ± 30 BP, LU 2435.**

**Figure 19. Profile B. A fragment near B5 picket seen from the west.**

**Figure 20. Profile B, B5 picket, blown up. The ice interbed 10 to 15 cm thick is easily visible. View from the west.**

**Figure 21. Ruins of wooden structure (flooring-like construction) discovered in Squares 1 and 2, excavations of 1989 (Fig. 12). Seen from the SW.**

**Figure 22. A section of cultural layer in excavating the west part of the dig (Square 28) with abundant wooden pieces, some of which are in vertical position or inclined at an angle to a surface.**

**Figure 23. Subsurface ice vein, about 3 meters thick, discovered along the east slope of the thermokarst depression covering the center of the dig (excavations of the 1990 field season).**

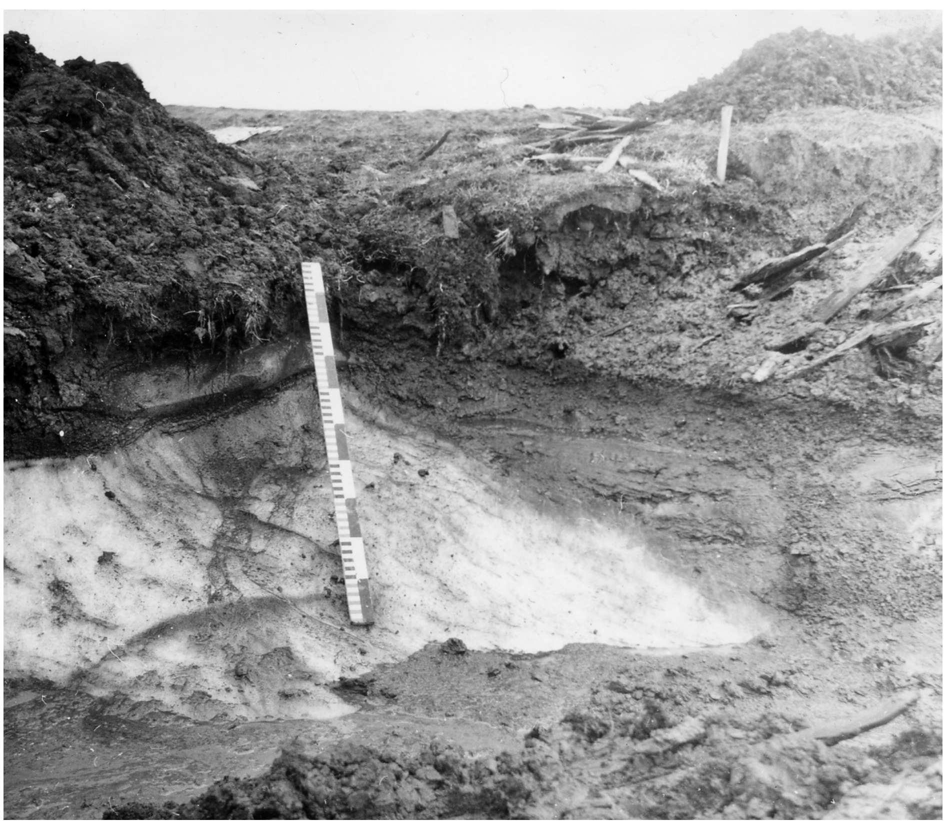

**Figure 24. Square 41, profiles seen from the NW.**

**Figure 25. Polar bear skull discovered in excavating Square 41. Seen from the NW.**

**Figure 26. A piece of sledge-runner found in Square 62, east part of the excavated area. View from the NW.**

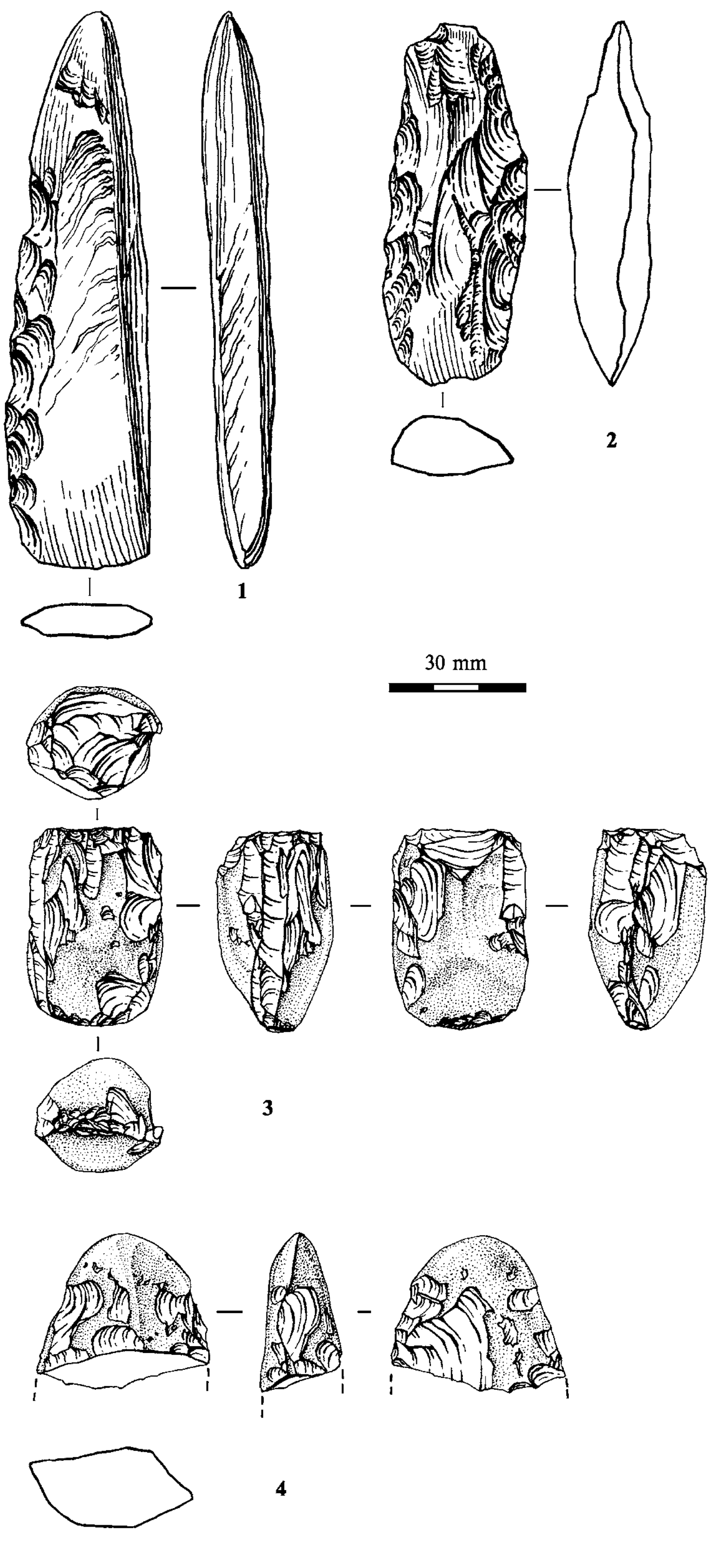


**Figure 27. Stone implements from the Zhokhv Island site: (1, 2) ground axes (surface findings of 1989); (3, 4) fragments of such tools discovered in the cultural layer in 1990; (3) an attempt at reshaping a broken axe into a microblade core.**

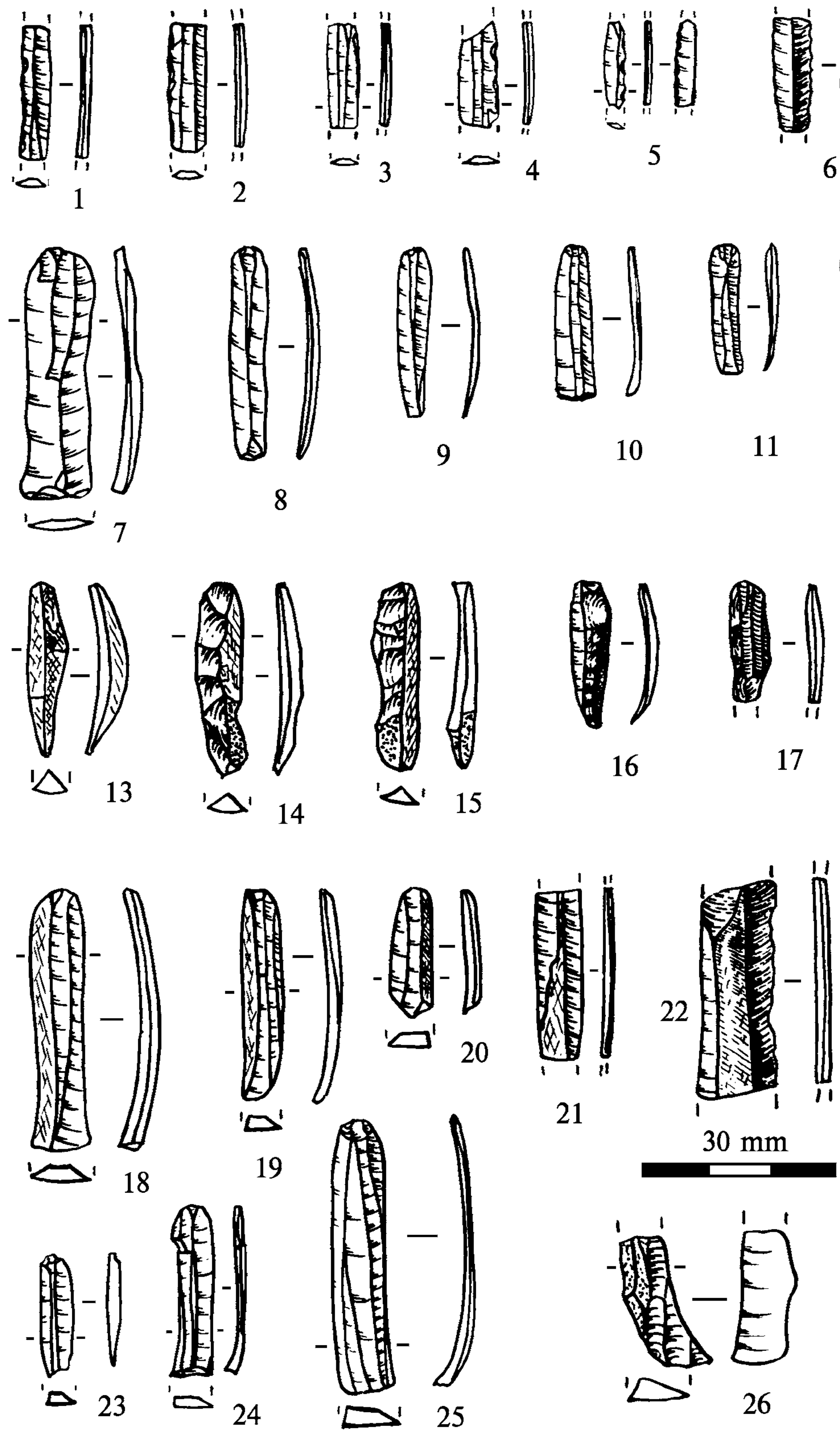


**Figure 28. Stone industry of the Zhokhov Island site. Flint insets, lamellar flakes, and bladelets: (1–6) insets; (7–12) bladelets; (13–26) flakes removed in forming the prismatic relief of the core flaking surface.**

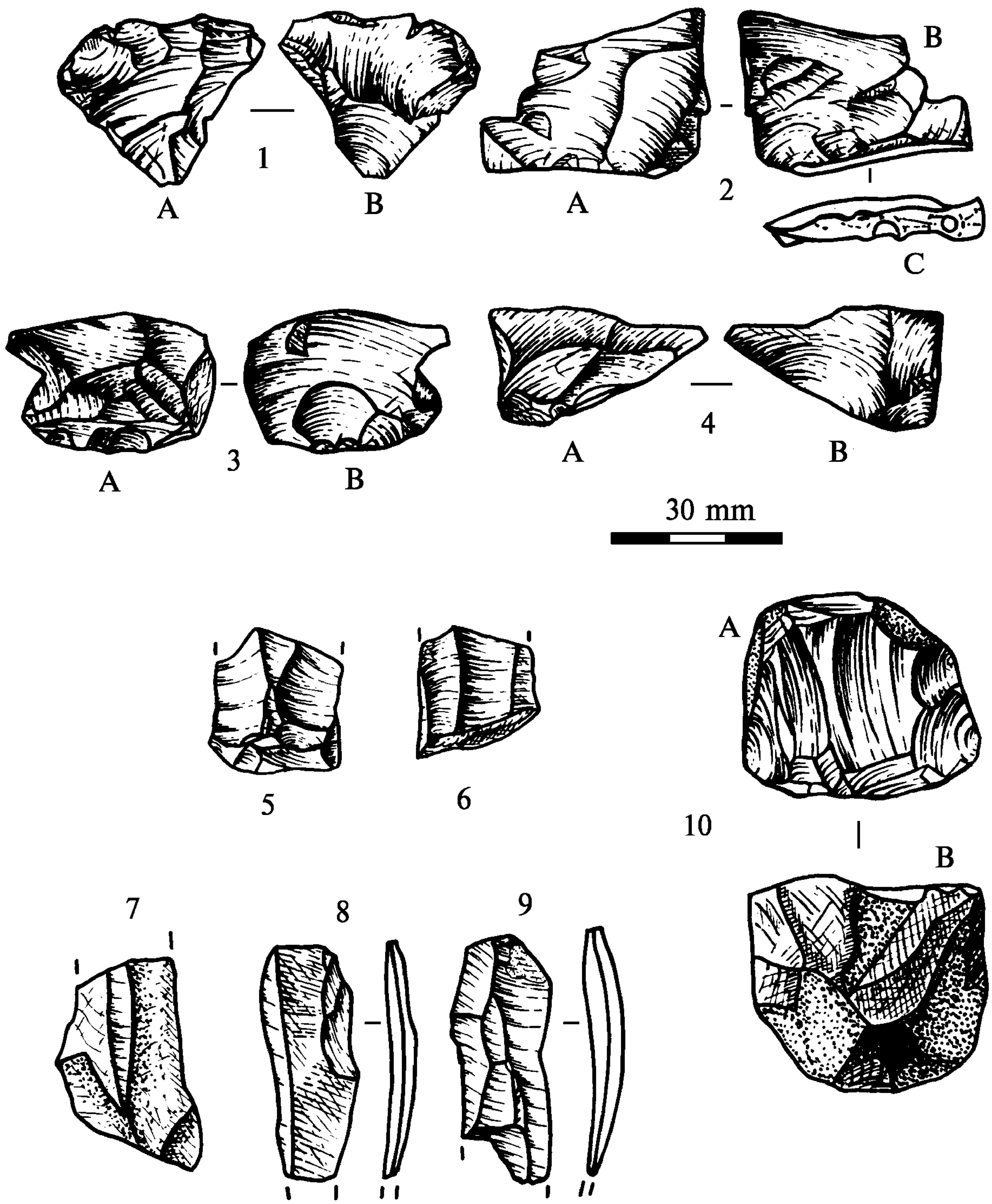


**Figure 29. Stone artifacts of the Zhokhov Island site: (1–4) flakes for shaping of platforms on core preforms; (5–9) fragments of large blades; (10) core preform.**

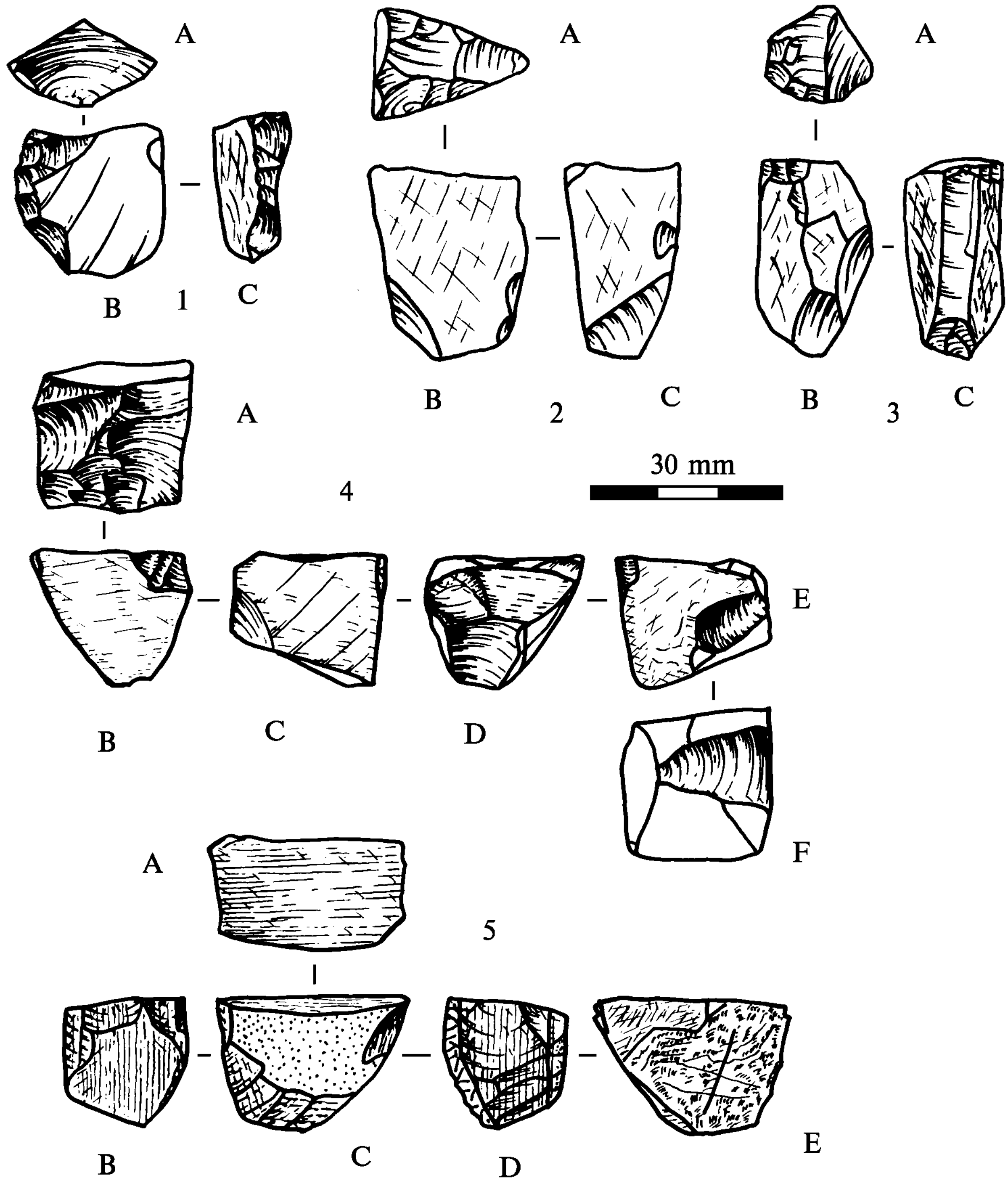


**Figure 30. Core preforms from the Zhokhov Island site (1–5).**

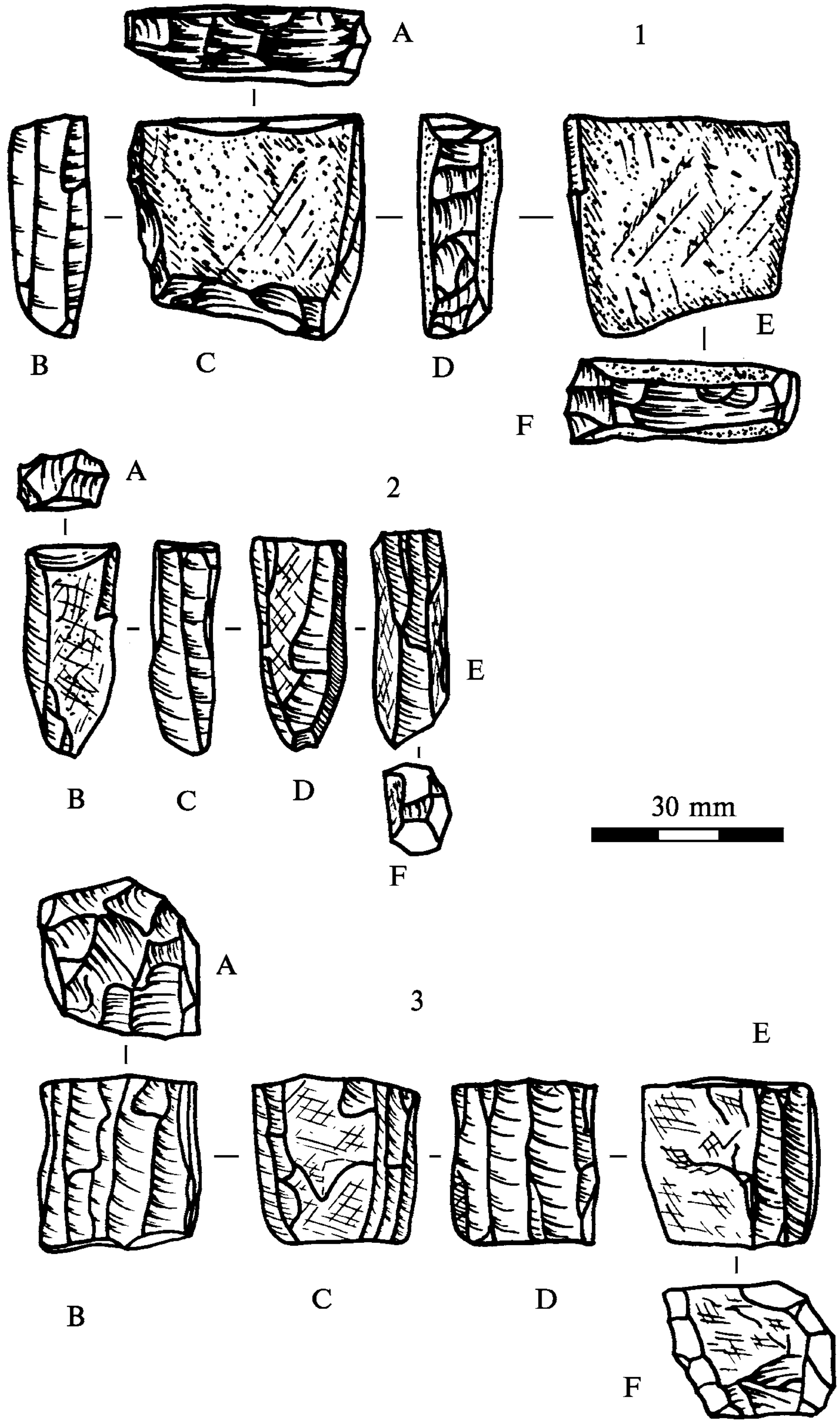


**Figure 31. Cores from the Zhokhov Island site: (1) prismatic core with one flaking surface (tortsovy type) and with a flattened platform and base, prepared to begin shaping a second flaking surface; (2) core with two opposing flaking surfaces and the process of shaping a third flaking surface in its initial stage; (3) core with two opposing flaking surfaces.**

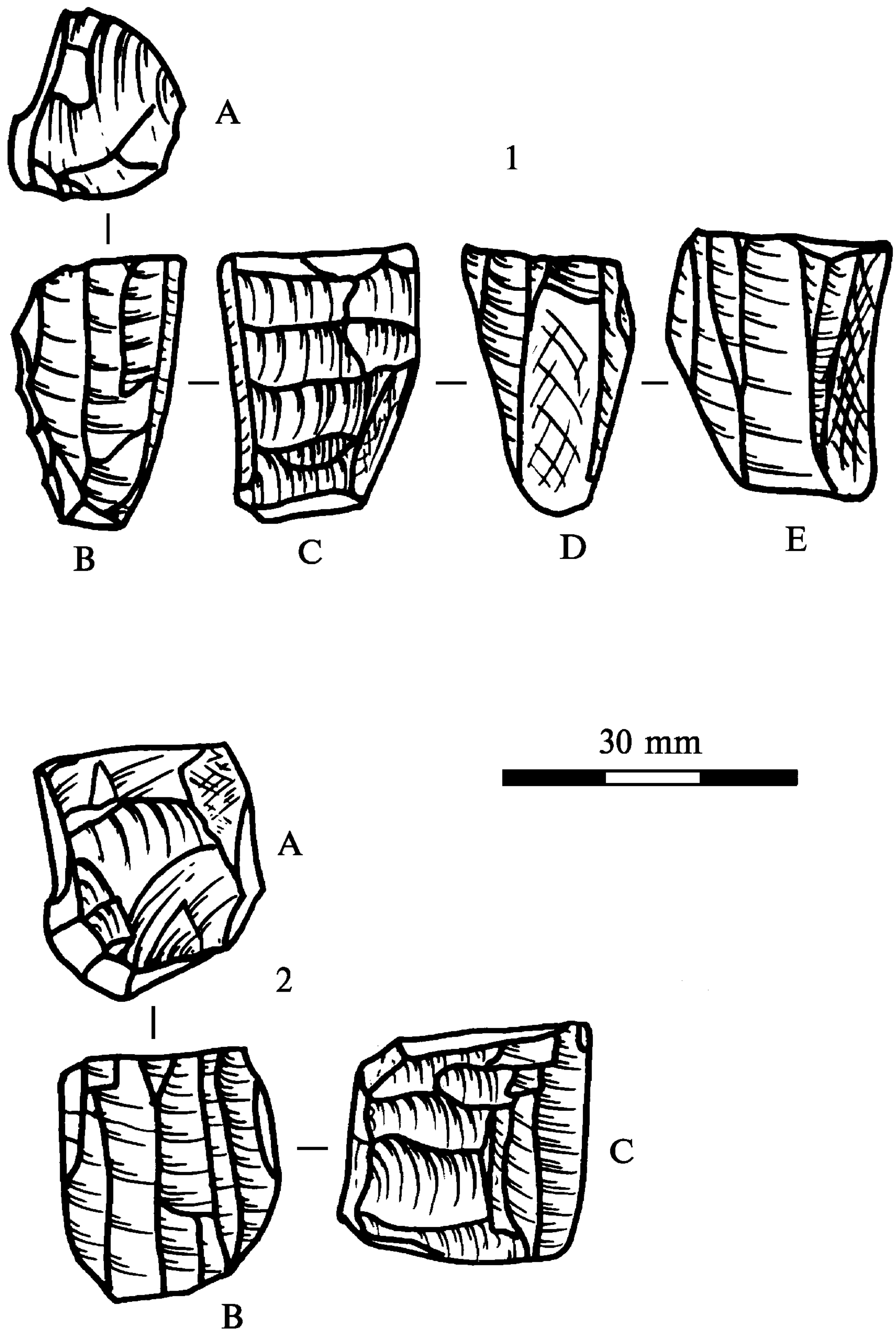


**Figure 32. Cores from the Zhokhov Island site with trimming of lateral core surfaces by transverse flaking (1, 2).**

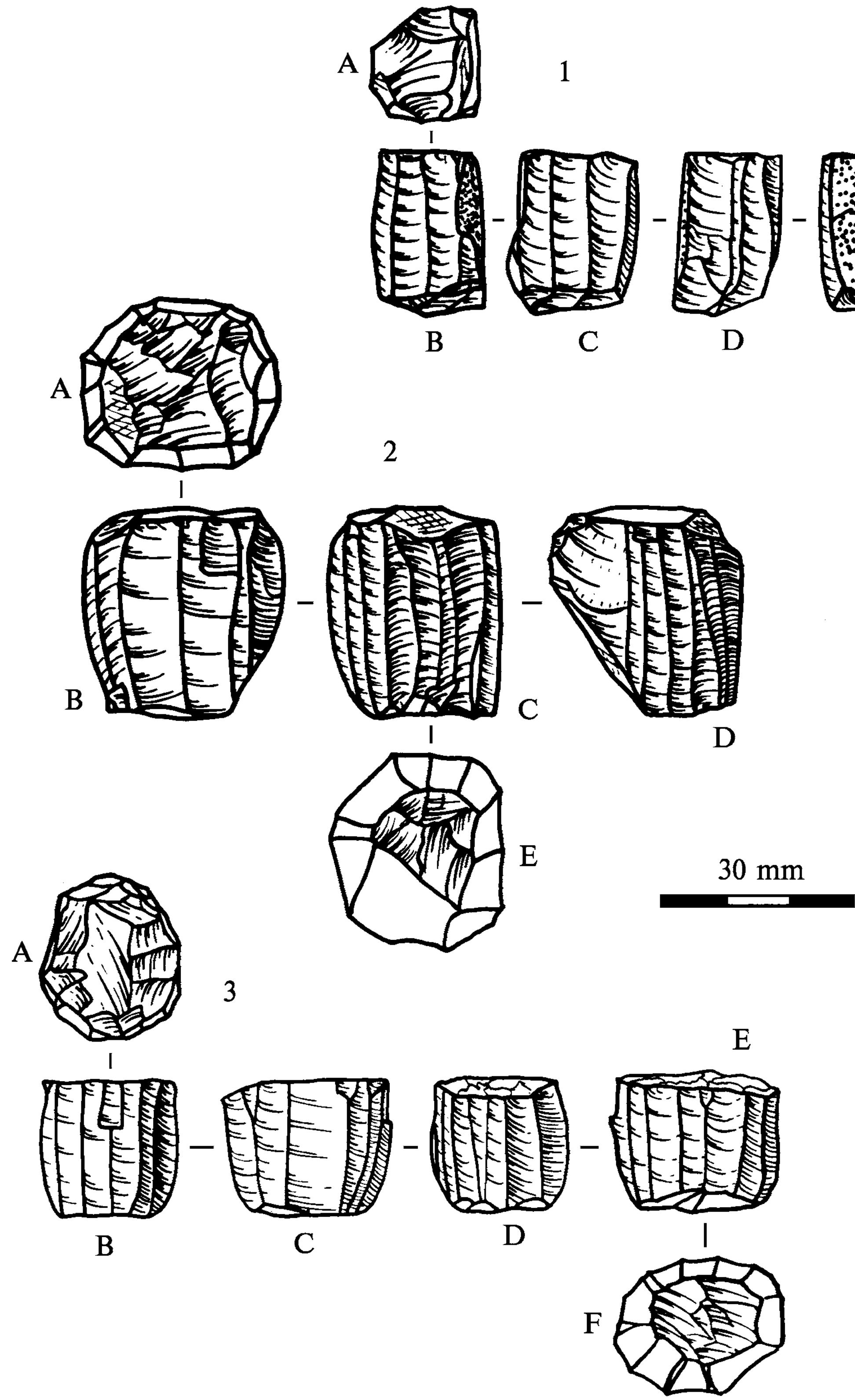


**Figure 33. Cores from the Zhokhov Island site: (1) core with three flaking surfaces and initial shaping of a fourth; (2) core with three flaking surfaces; (3) core with four flaking surfaces.**

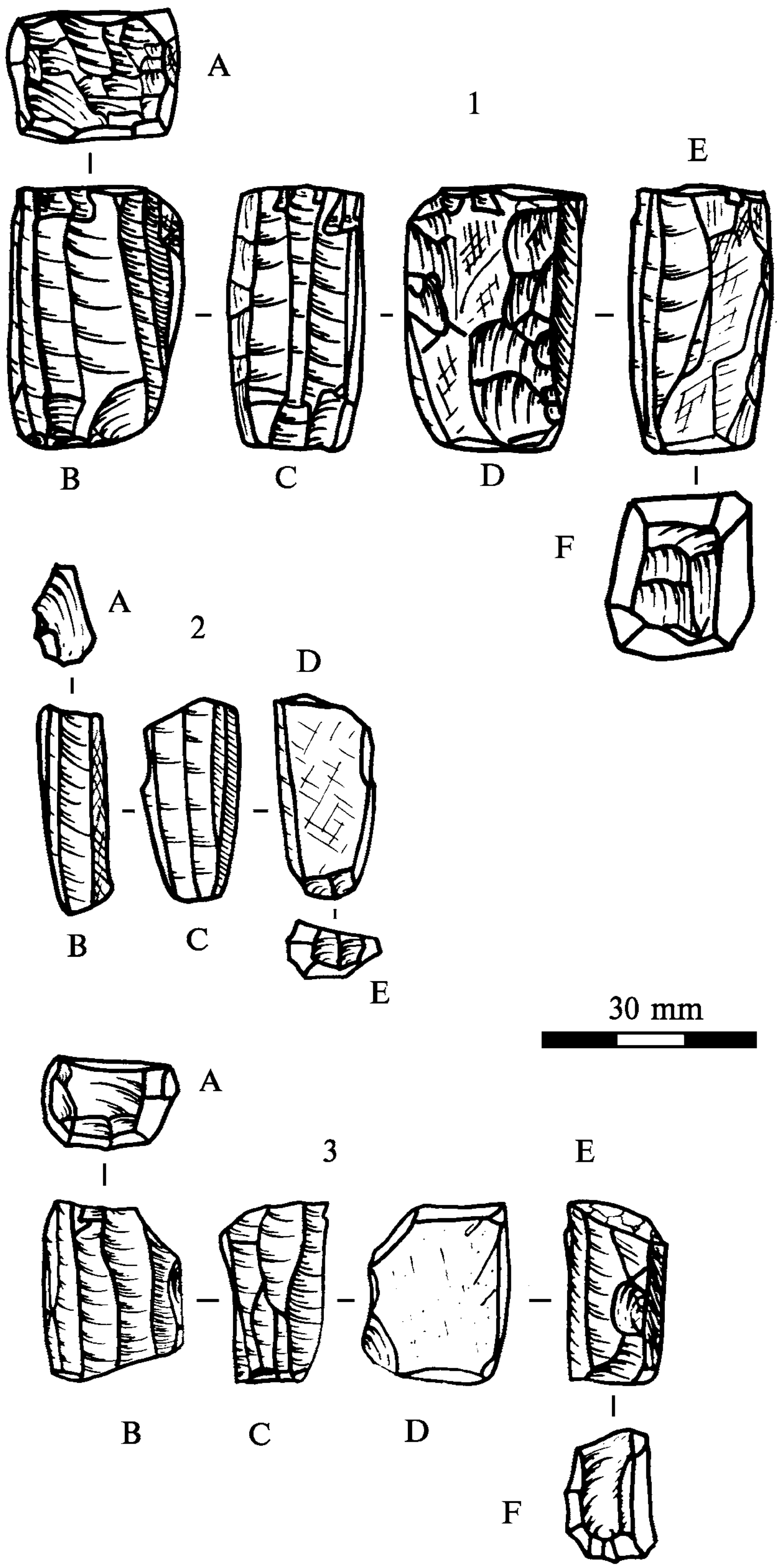


**Figure 34. Cores from the Zhokhov Island site: (1) core with two adjacent flaking surfaces, with the process of shaping the third flaking surface; (2, 3) cores with three adjacent flaking surfaces.**

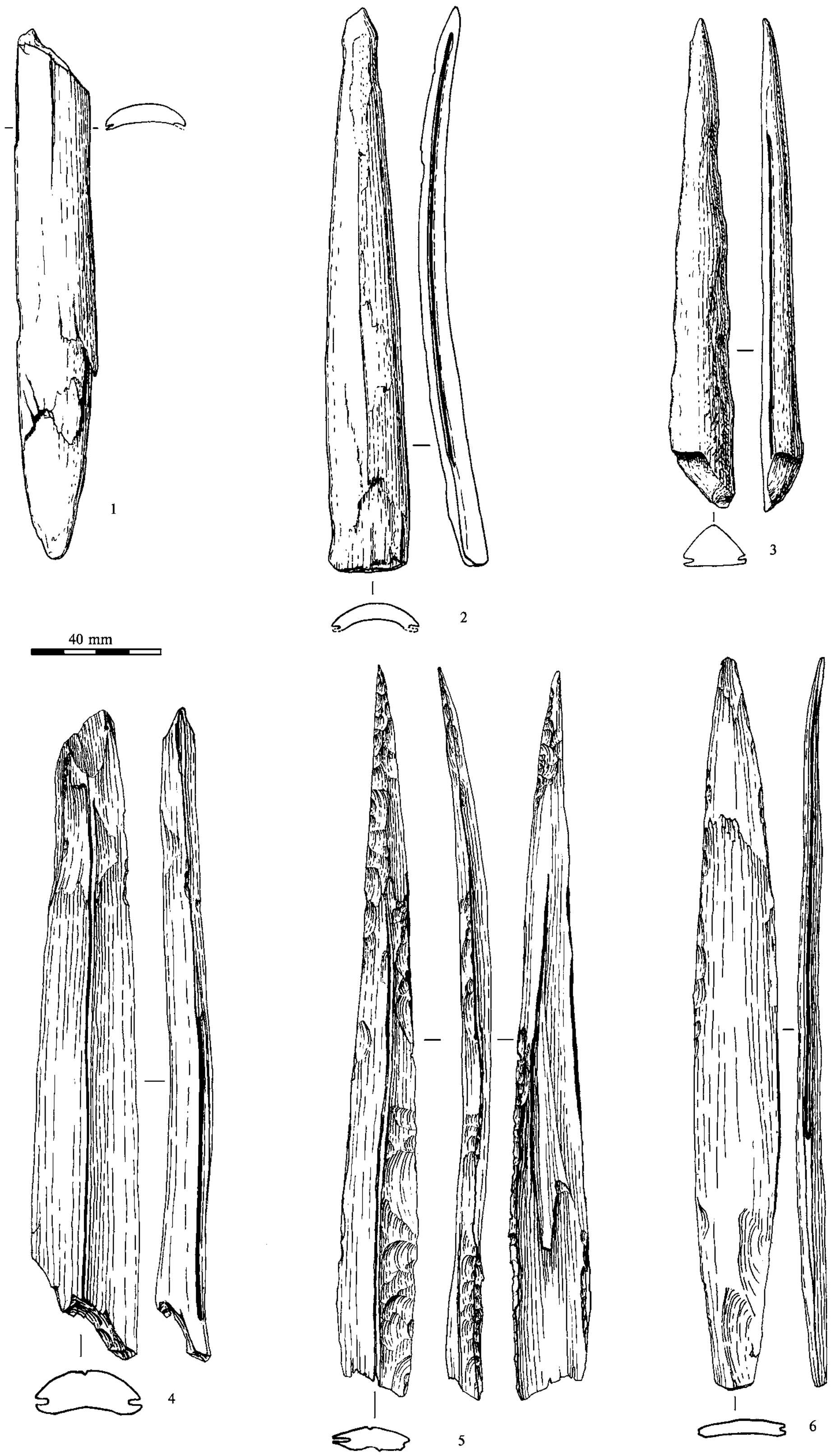


**Figure 35. Hunting equipment from the Zhokhov Island site: bilateral (1–5) and unilateral (6) tools with side grooves; (1, 2, 4) of antler, (5, 6) of bone, (3) of mammoth ivory.**

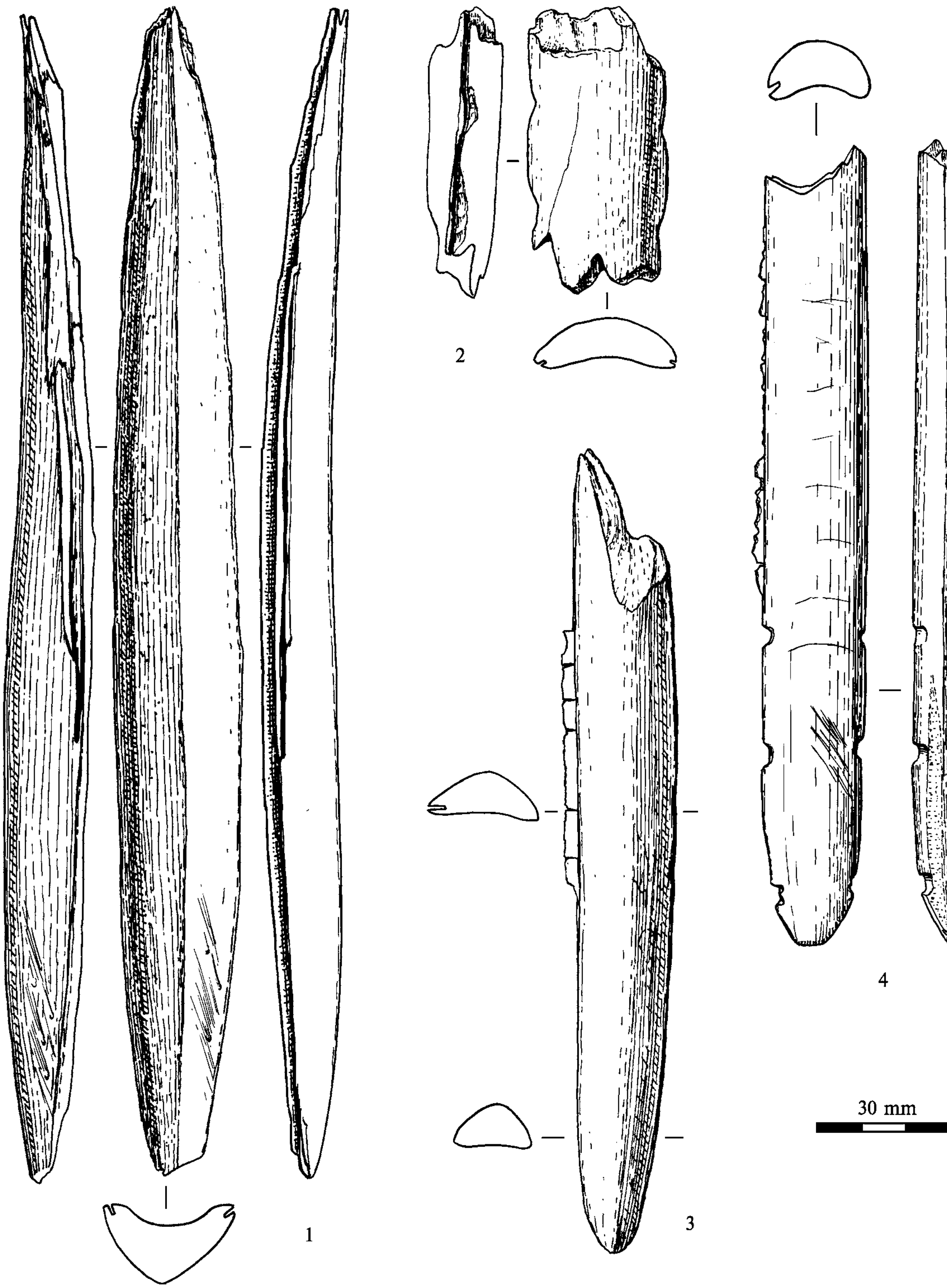


**Figure 36. Hunting equipment from the Zhokhov Island site: bilateral side-grooved, massive point of antler, with three-edged cross section (1), and (2) fragment of bilateral side-grooved point with unilateral convex cross section, and with three pairs of grooves for mounting with a binding strip; (3, 4) unilateral side-bladed point (fragmented) with side blades in situ, and with unilateral convex cross section; one of the latter (4) has additional shaping at the base such as found on a bilateral point (2); (1–3) of antler, (4) of walrus tusk.**

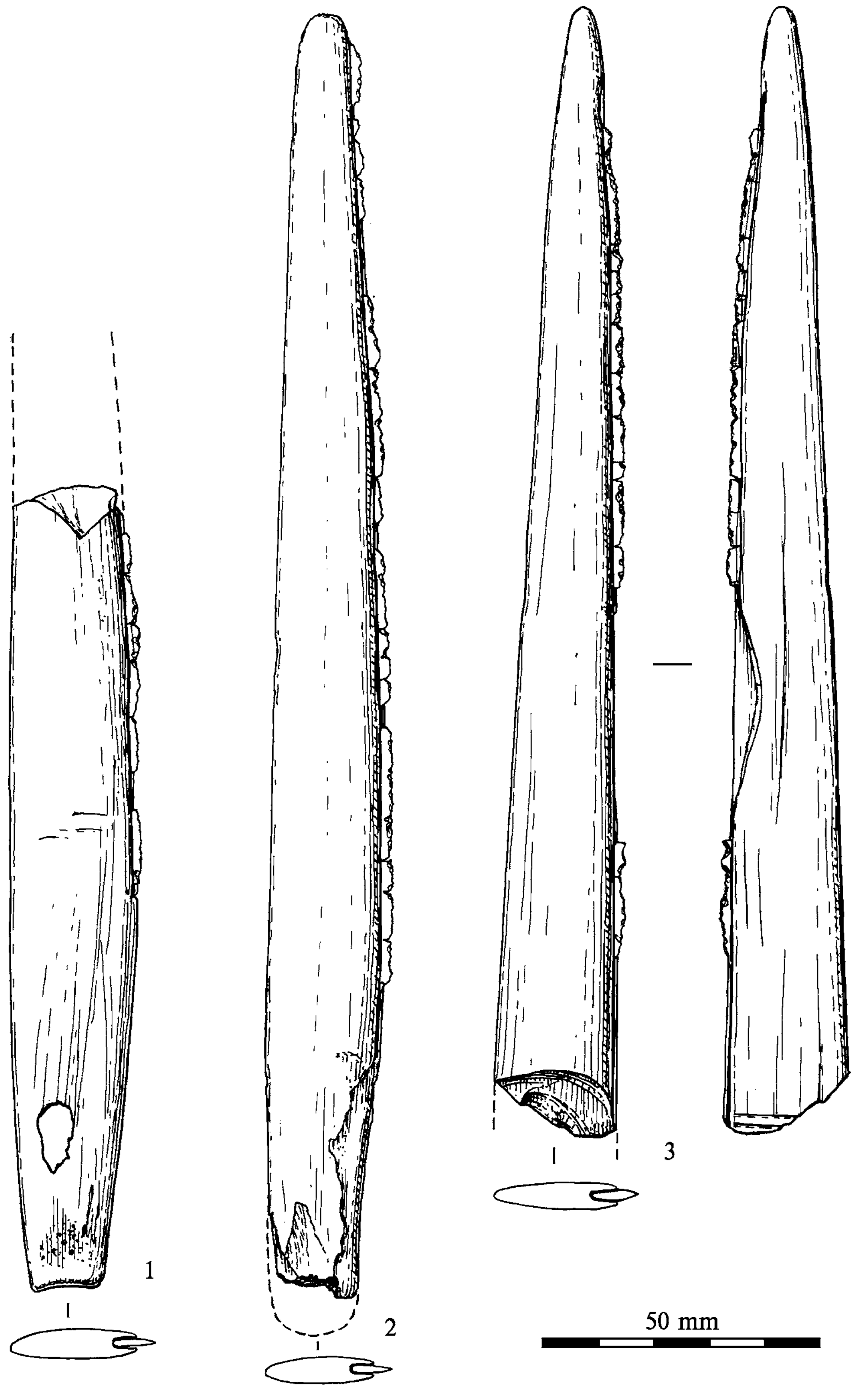


**Figure 37. Compound tools from the Zhokhov Island site ("knives" ?). Unilaterally side-bladed tools with side blades in situ (all of bone).**

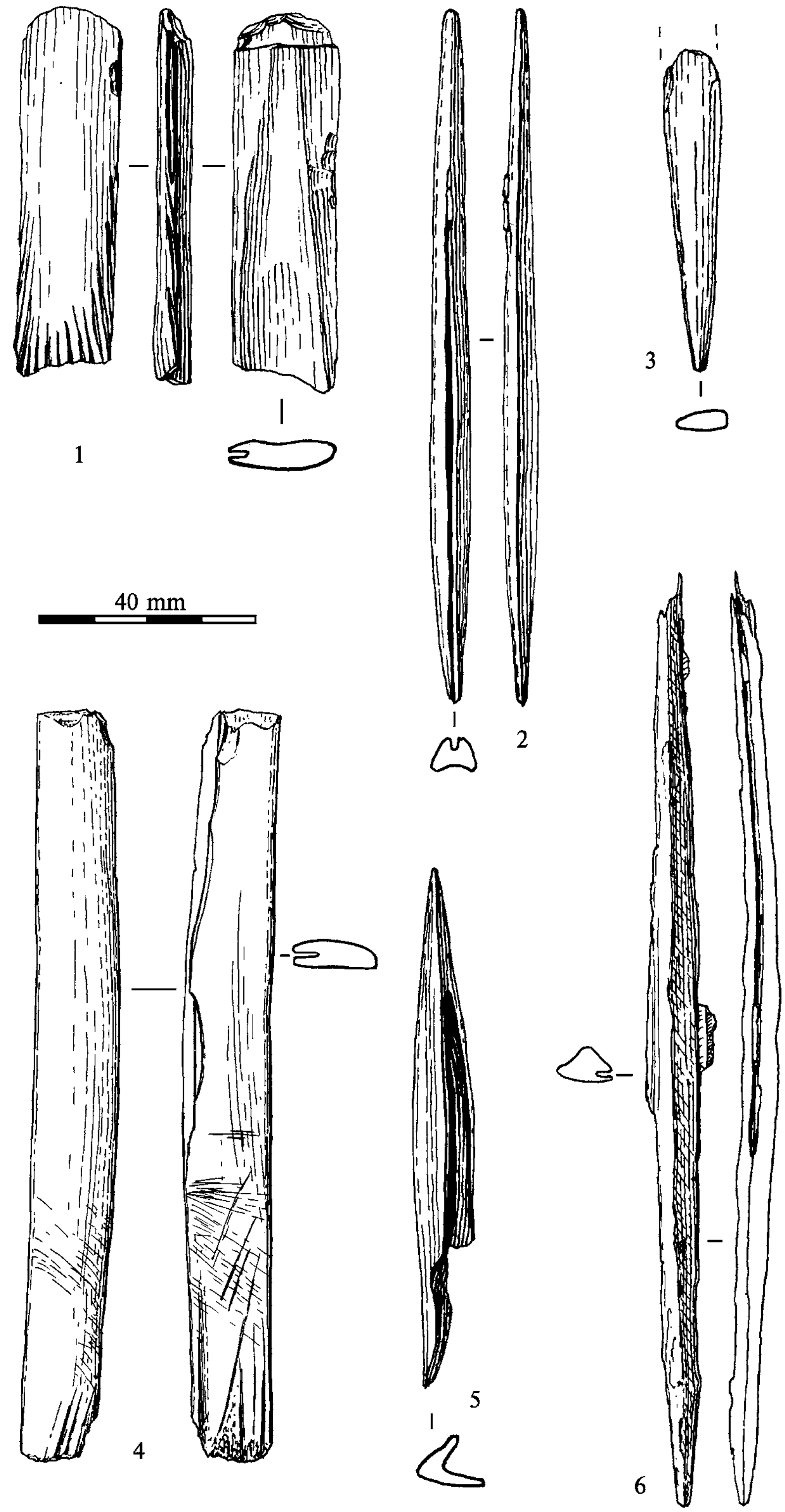


**Figure 38. Hunting equipment from the Zhokhov island site: fragments of unilateral side grooved dart points (1, 4); needle-shaped projectile points with one groove and side blades partly preserved *in situ* (2, 6); fragment of bone point (3); non-bladed missile point of simplest type. All of the artifacts are made of bone.**

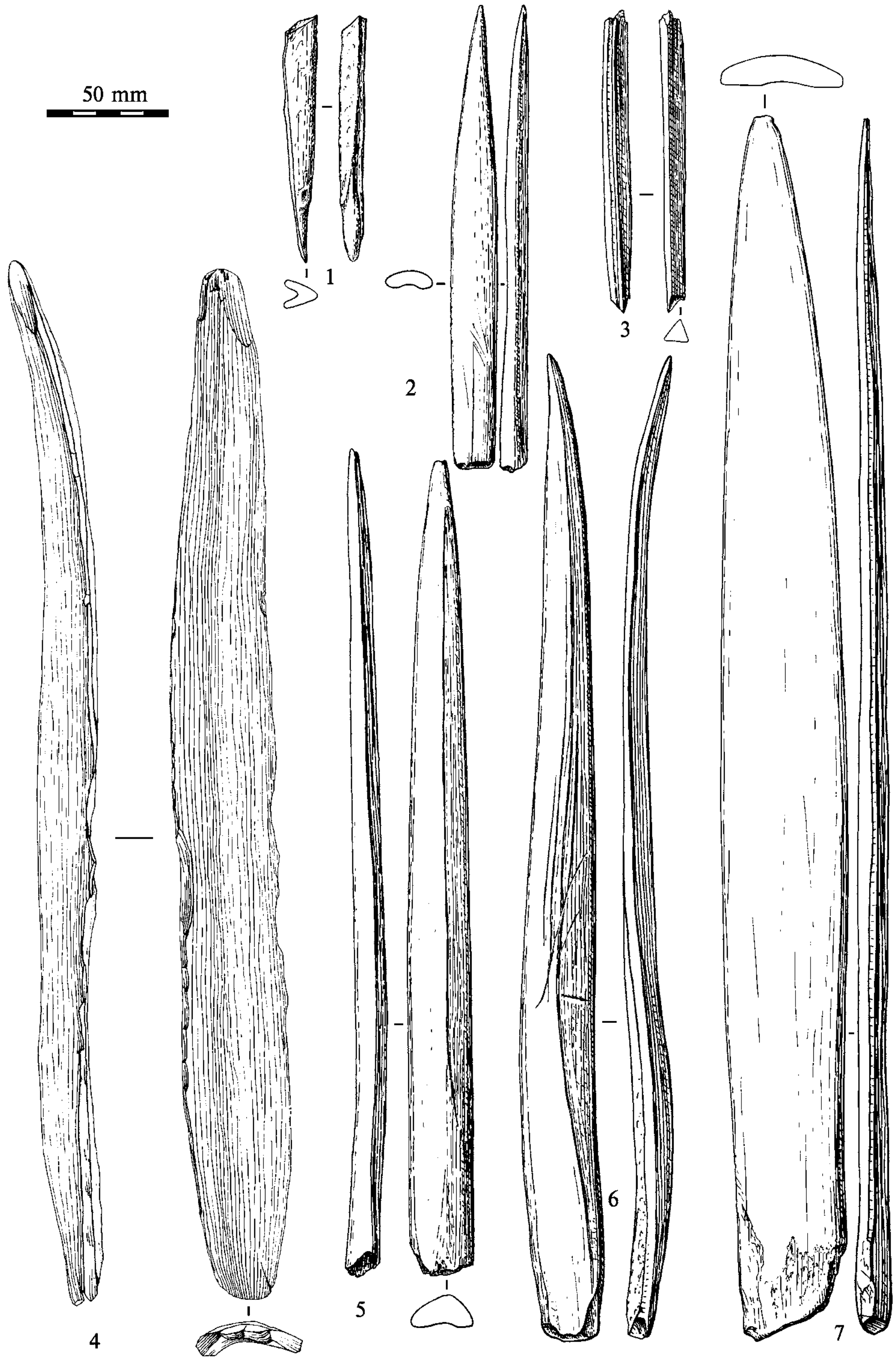


**Figure 39. Hunting equipment from the Zhokhov Island site: (1–3) fragments of small missile points (of bone); (4) antler preform in initial stage of treatment; (5, 6) broken bilateral side-grooved tools in reshaping, with former grooves abraded almost totally (4–of bone, 5–of antler); (7) a preform of large a bilateral side-bladed tool finished almost completely, in initial stage of the process (a long-bone of the fossil Pleistocene animal, well preserved in permafrost, was most likely used as raw material, as was the case with pickaxes of fossil mammoth ivory, Figs. 42, 45, 46).**

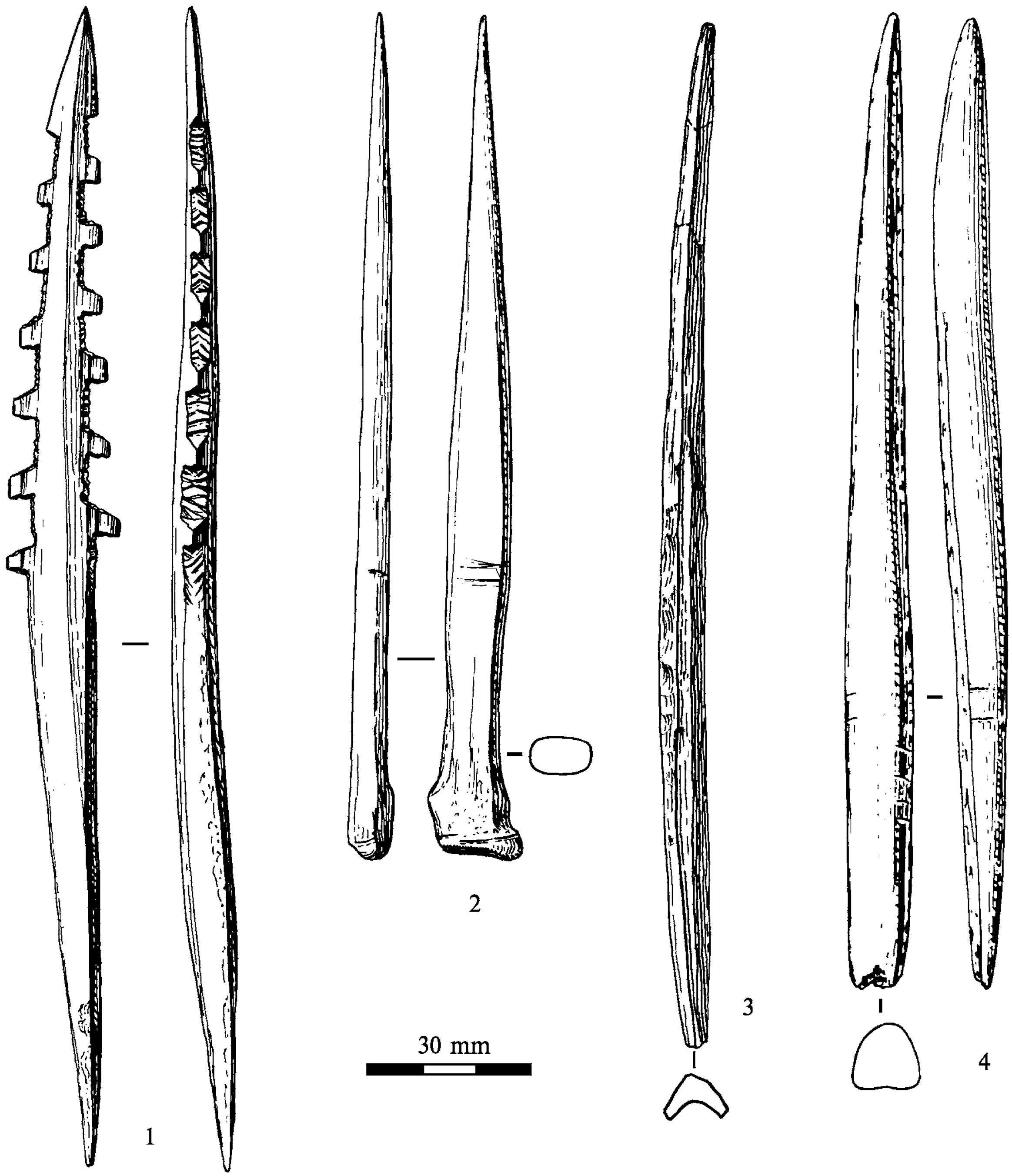


**Figure 40. Bone implements from the Zhokhov Island site: (1) fish-spear point; (2) awl; (3) regular needle-shaped projectile point (non-side-bladed or grooved). (1) of antler, (2, 3) of bone.**

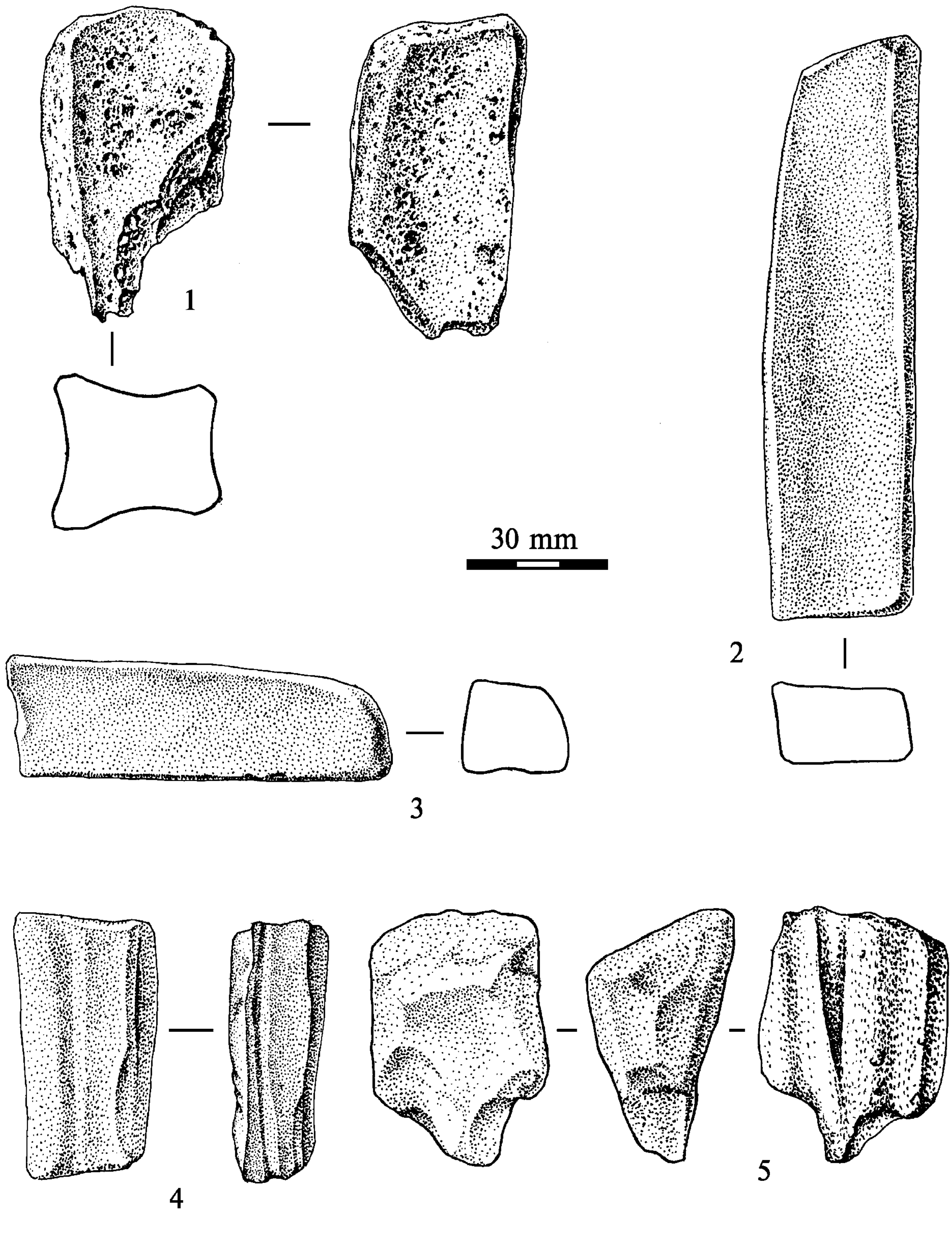


**Figure 41. Diverse coarse grinding stones from the Zhokhov Island site, (1) of pumice stone, (2–5) of sandstone.**

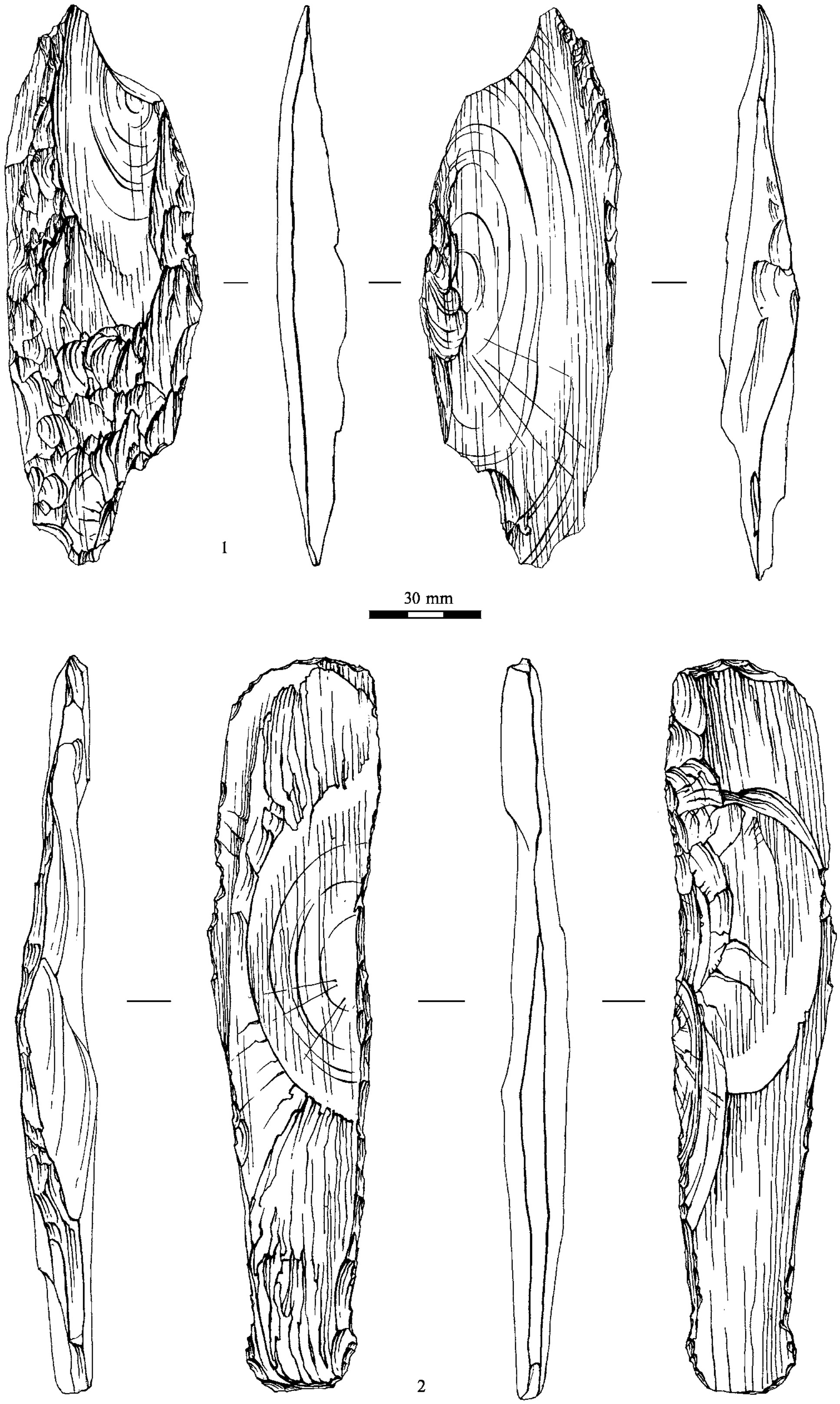


**Figure 42. Implements from the Zhokhov Island site made of mammoth ivory flakes: (1) side scraper; (2) skinning knife.**

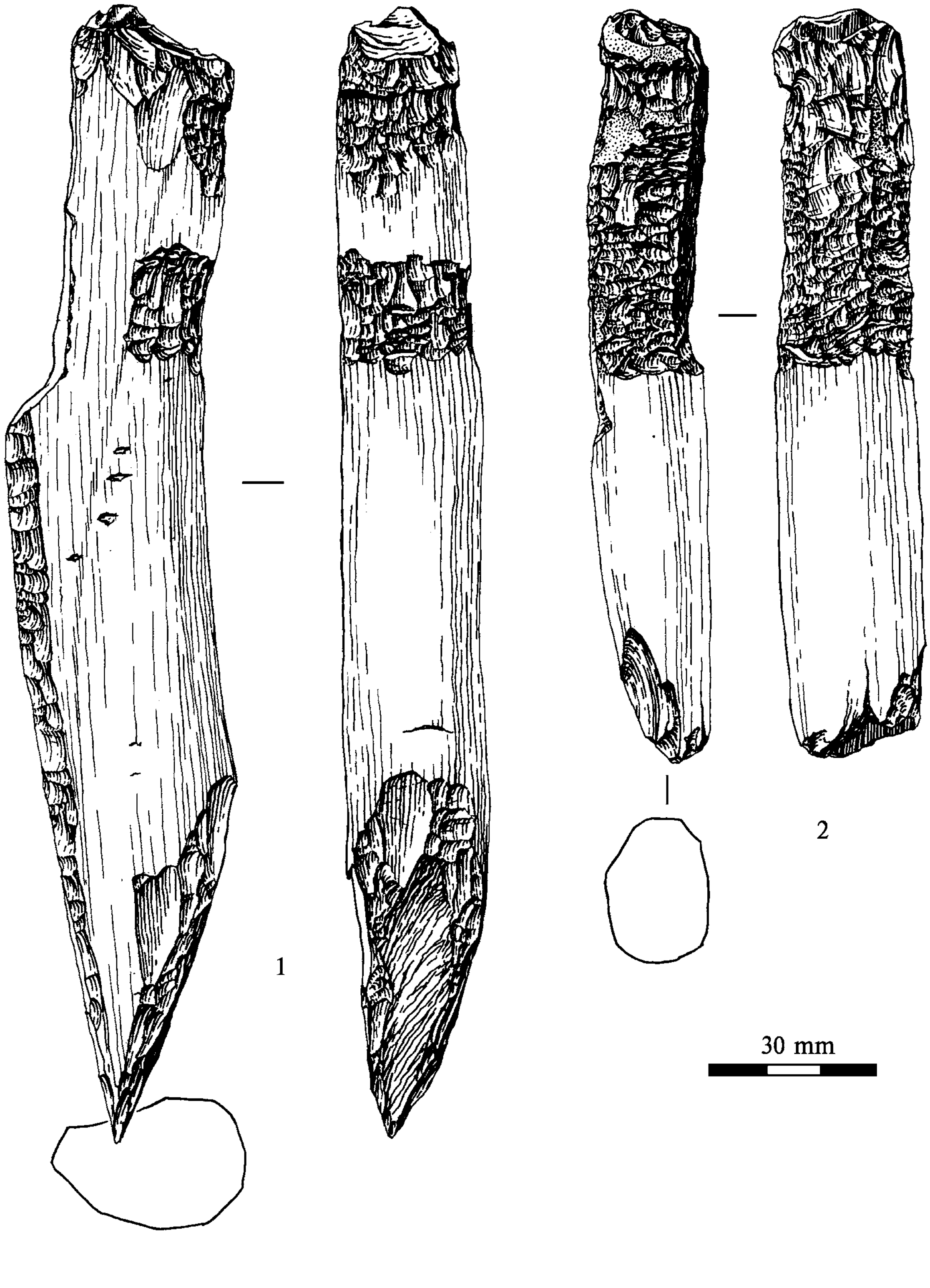


**Figure 43. Implements from the Zhokhov Island site. Pickaxes of antler (1, 2).**

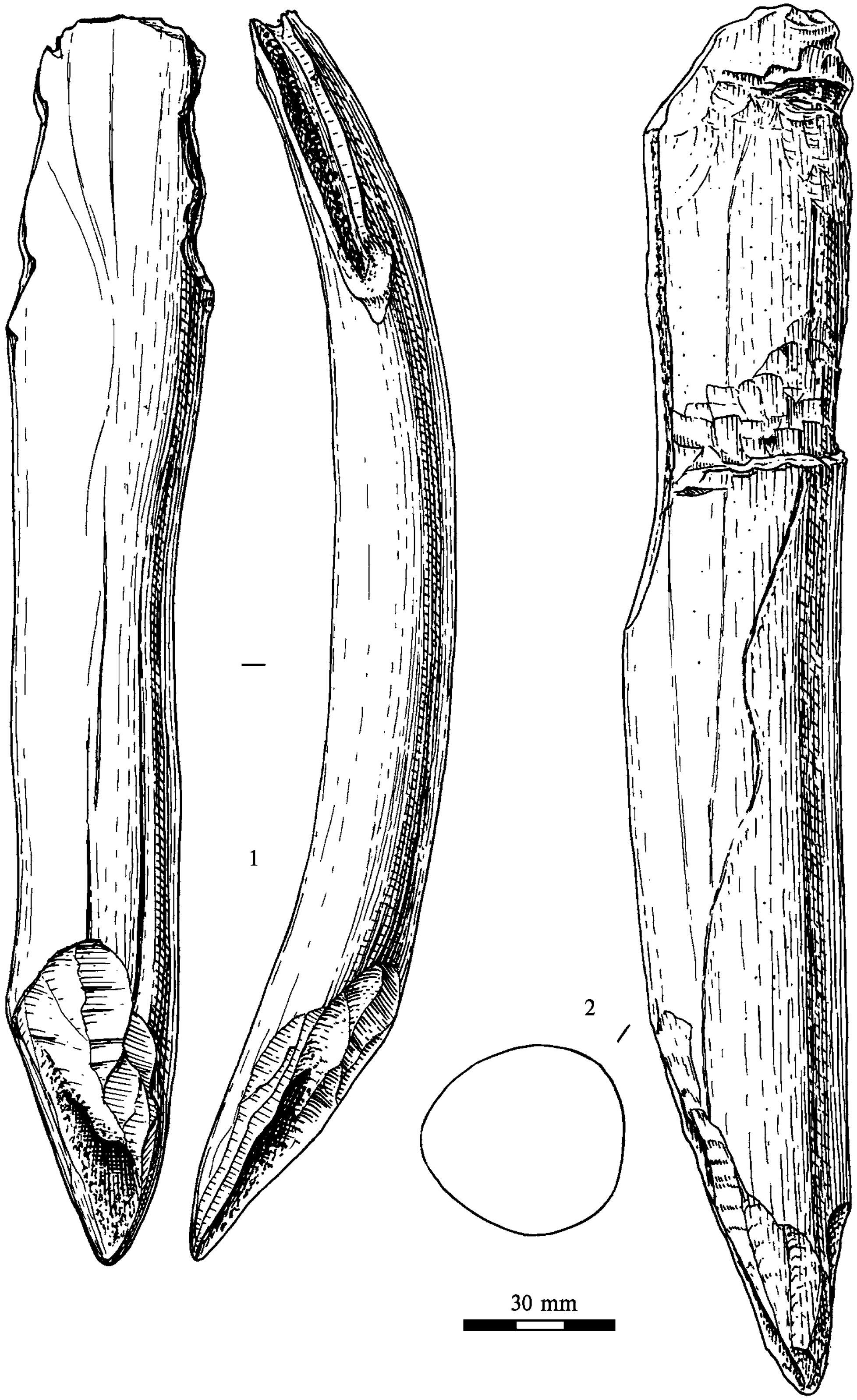


**Figure 44. Implements from the Zhokhov Island site. Pickaxes of antler (1, 2).**

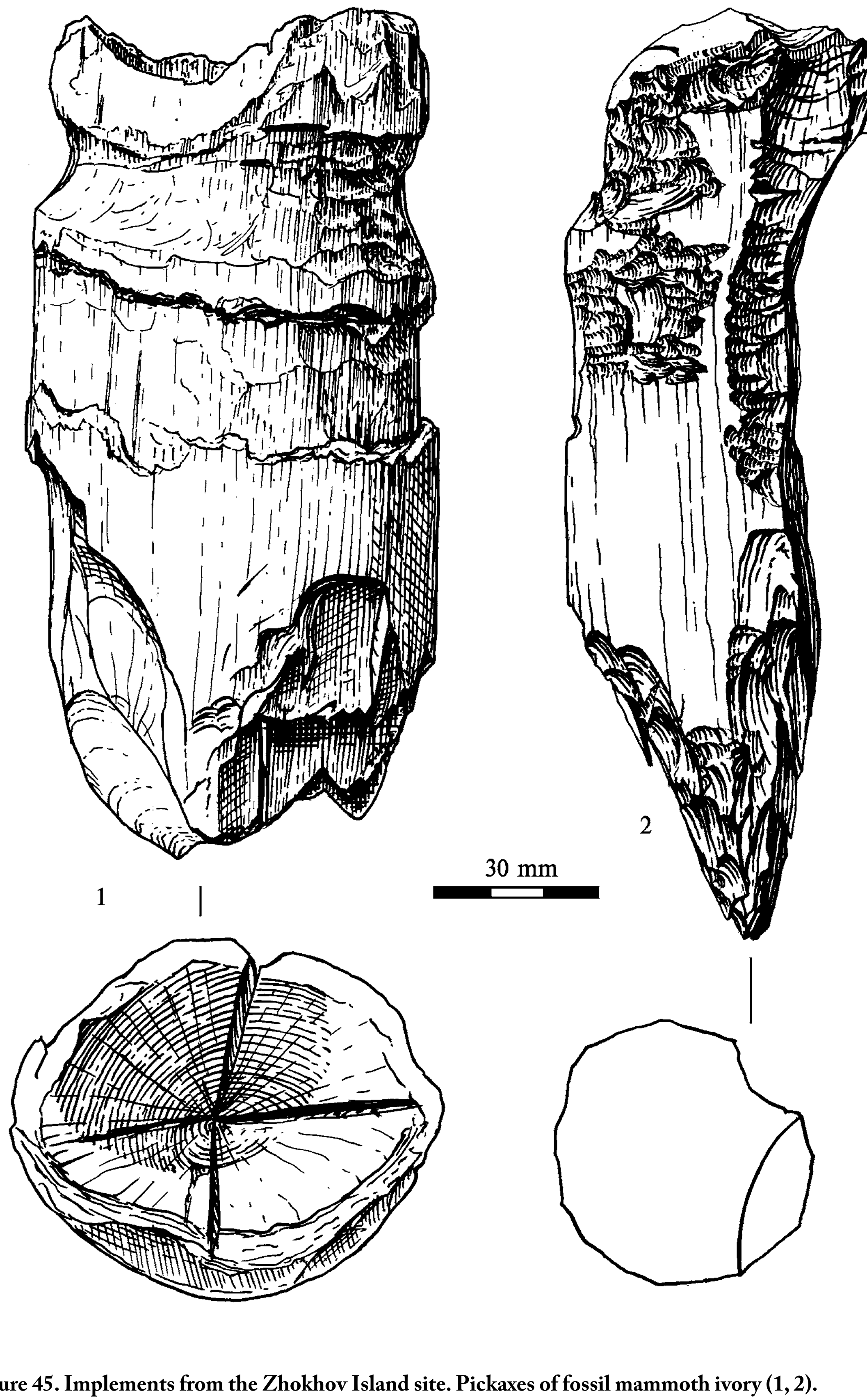


**Figure 45. Implements from the Zhokhov Island site. Pickaxes of fossil mammoth ivory (1, 2).**

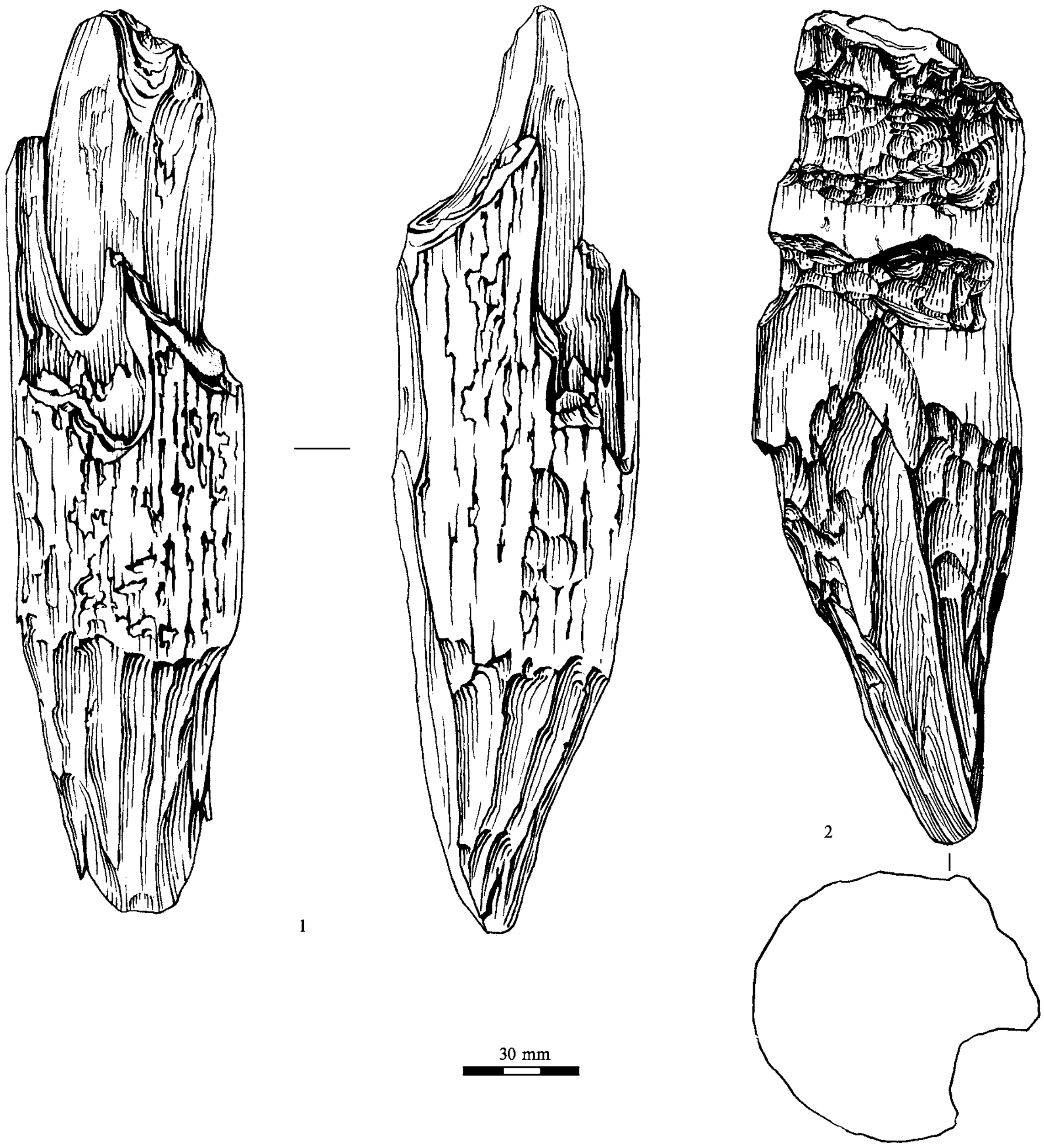


**Figure 46. Implements from the Zhokhov Island site. Pickaxes of fossil mammoth ivory (1, 2).**

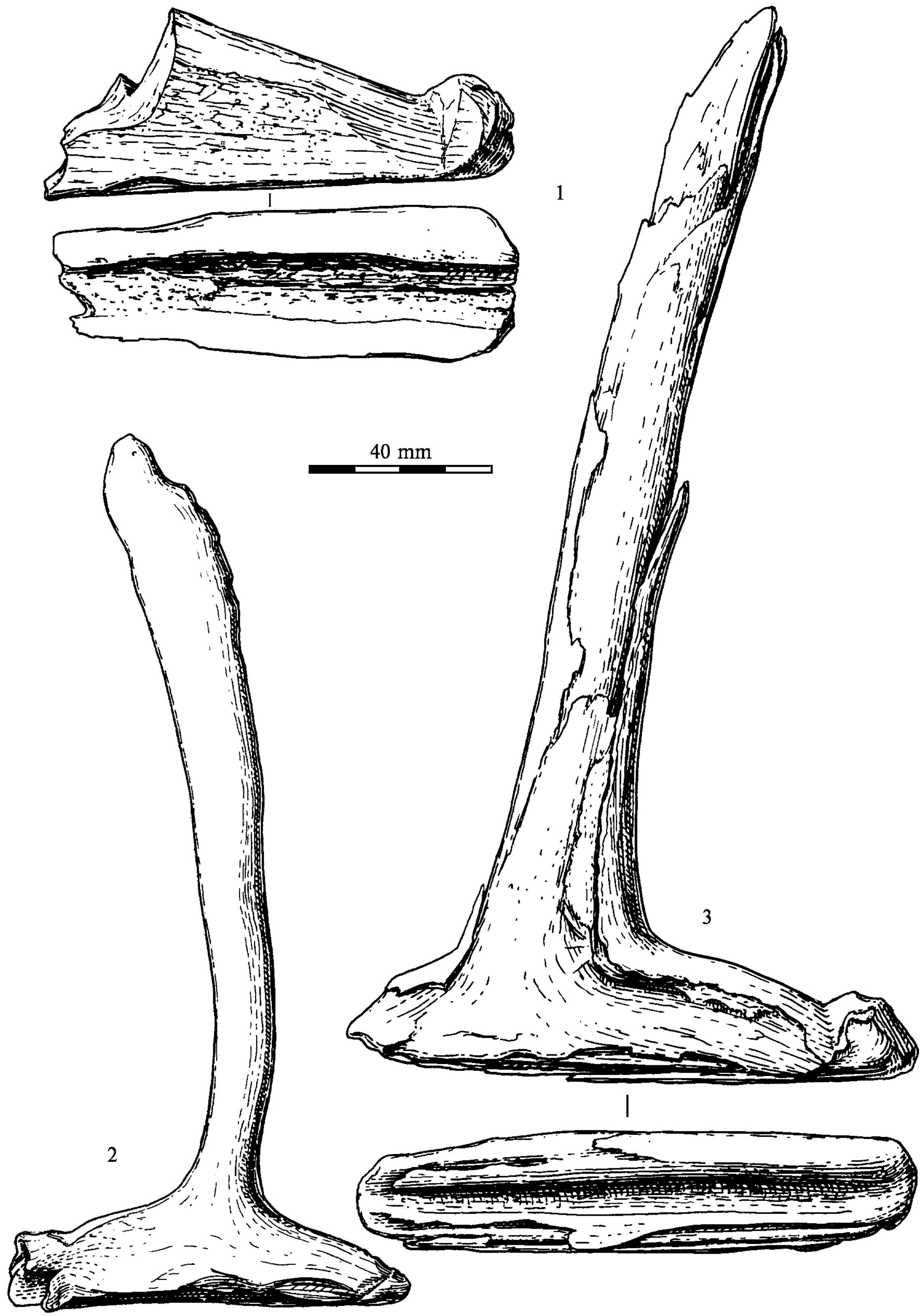


**Figure 47. Implements from the Zhokhov Island site. T- or L-shaped antler handles for hafting stone axes or chisels (2, 3); (1) fragment of such a tool.**

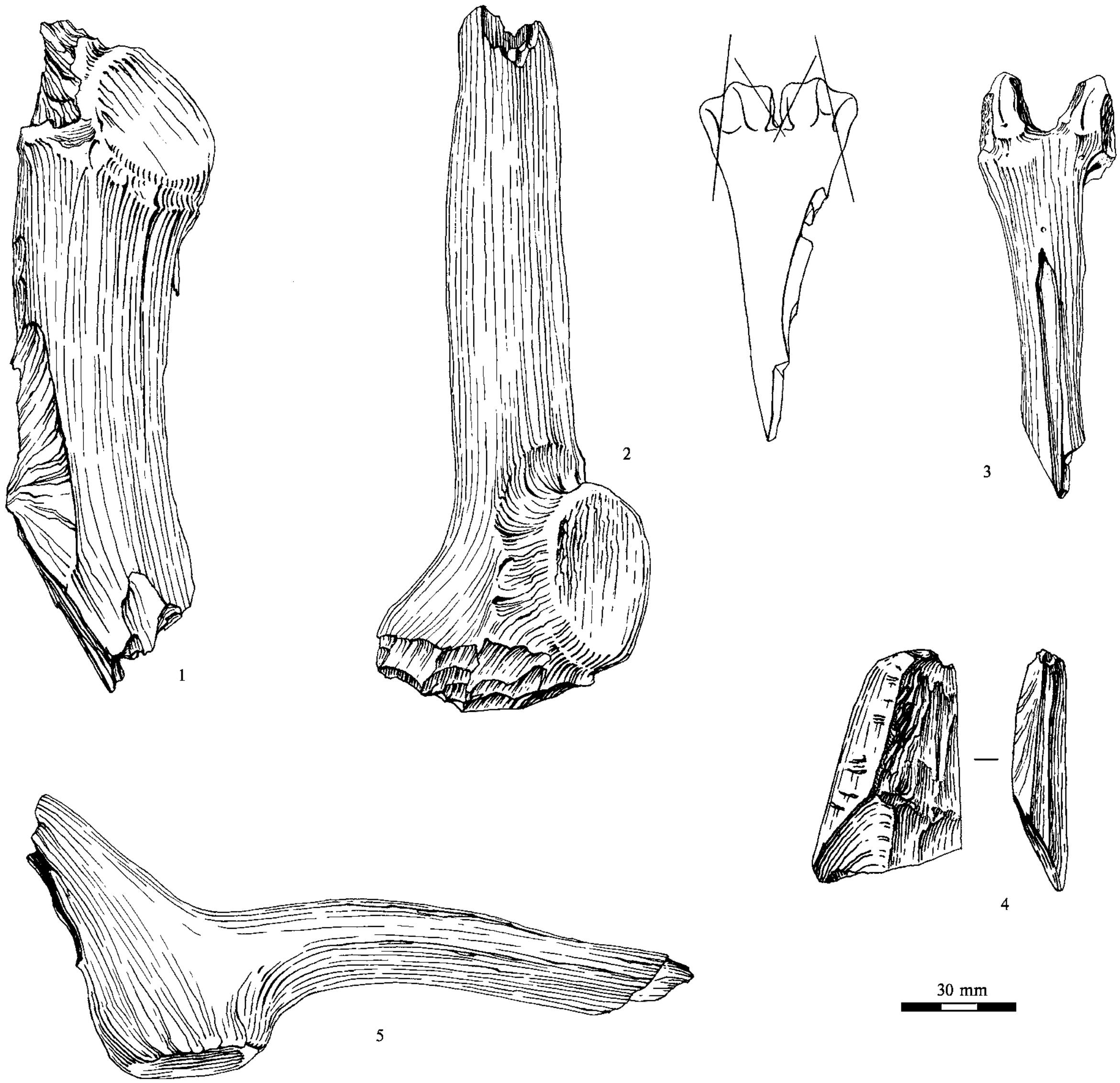


**Figure 48. Implements from the Zhokhov Island site: (1, 2, 5) hammers of antler stumps; (3, 4) unidentified articles: (3) reindeer metatarsal bone with a scheme of shaping, (4) a fragment of a massive ivory tool.**

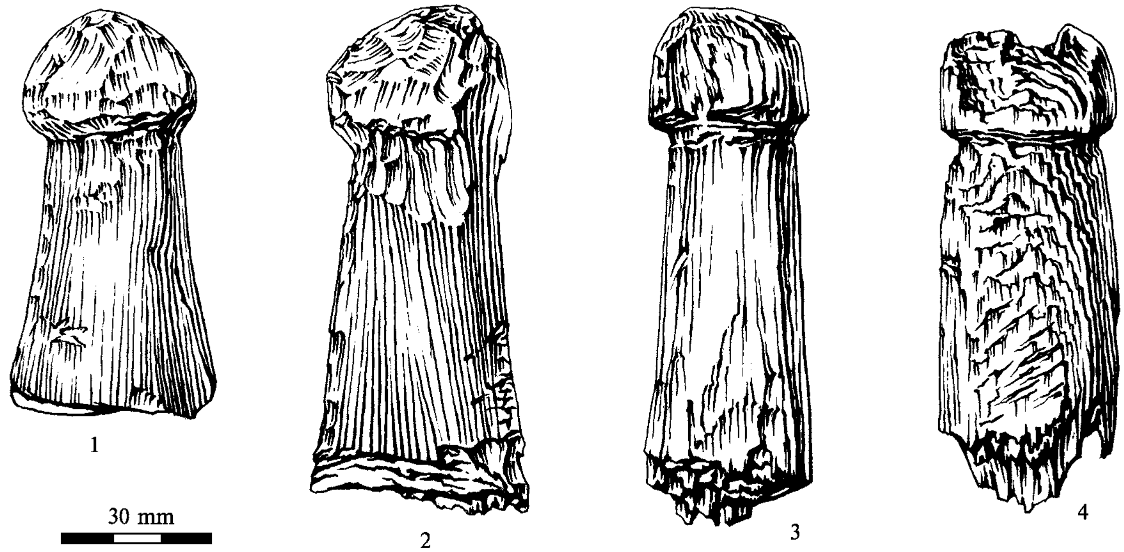


**Figure 49. Implements from the Zhokhov Island site. Unidentified handles broken from an artifact in the usual way: (1) of mammoth ivory, (2) of a massive bone, (3, 4) of wood.**

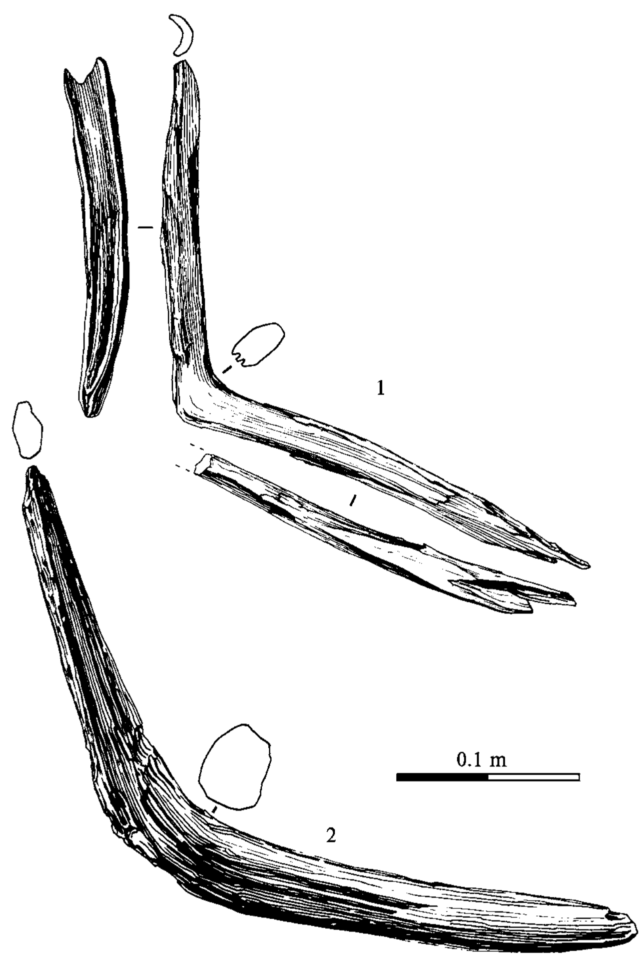


**Figure 50. Unidentified implements from the Zhokhov Island site. (1) of antler, (2) of wood.**

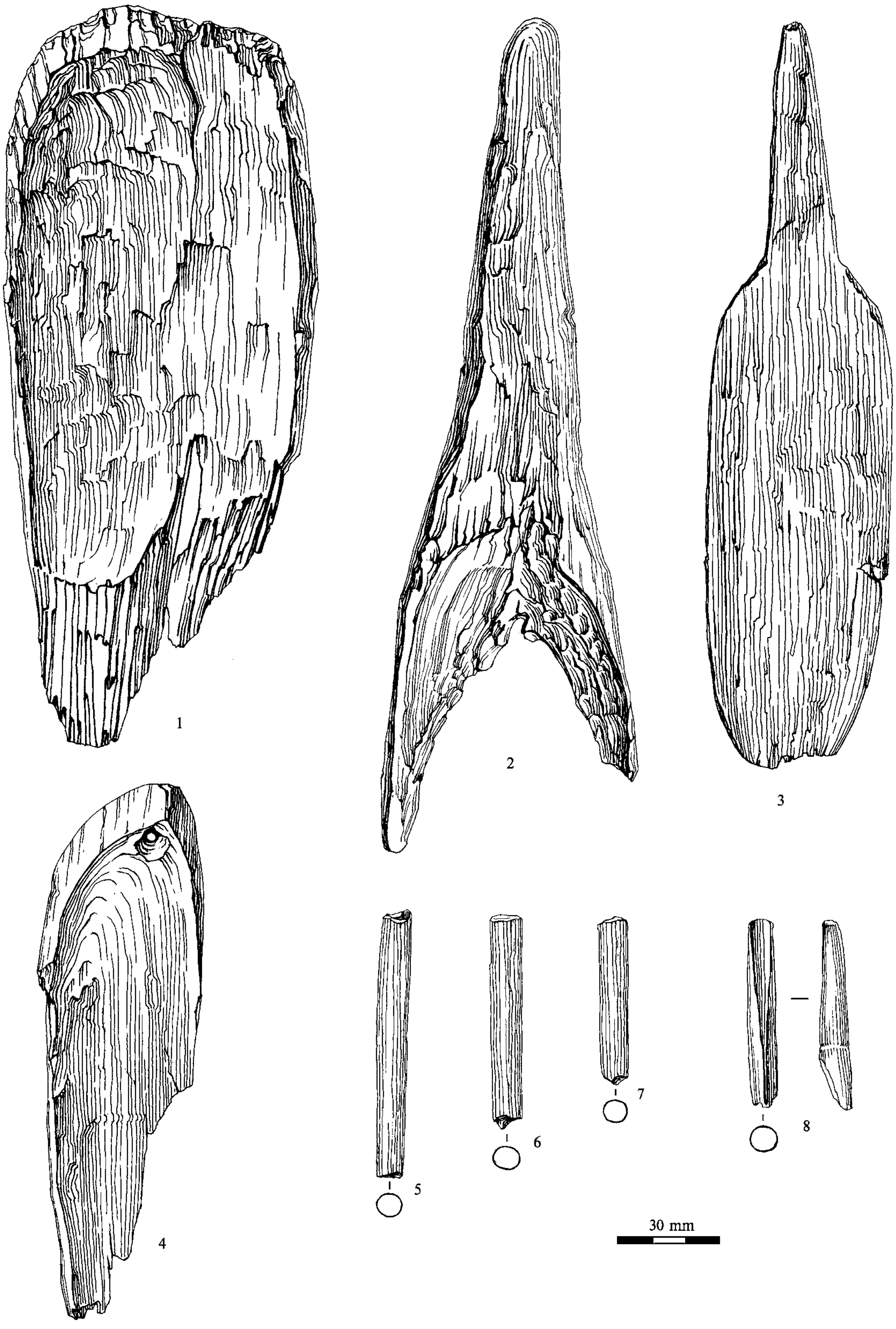


**Figure 51. Wooden artifacts from the Zhokhov Island site: (1, 2, 4) fragments of household equipment; (3) spoon or cooking ladle; (5–8) fragments of arrowshafts.**

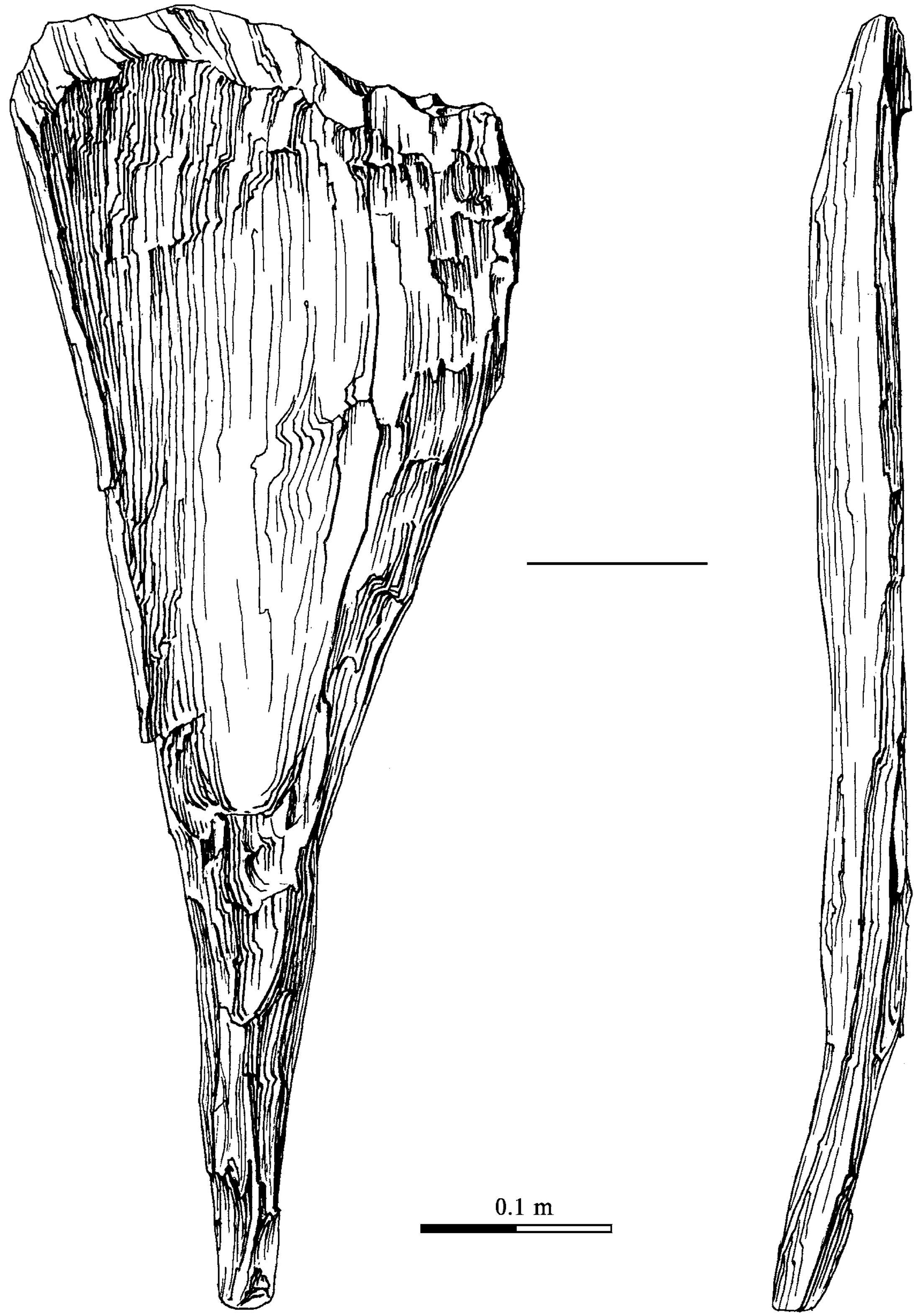


**Figure 52. Wooden artifact from the Zhokhov Island site. Household equipment.**

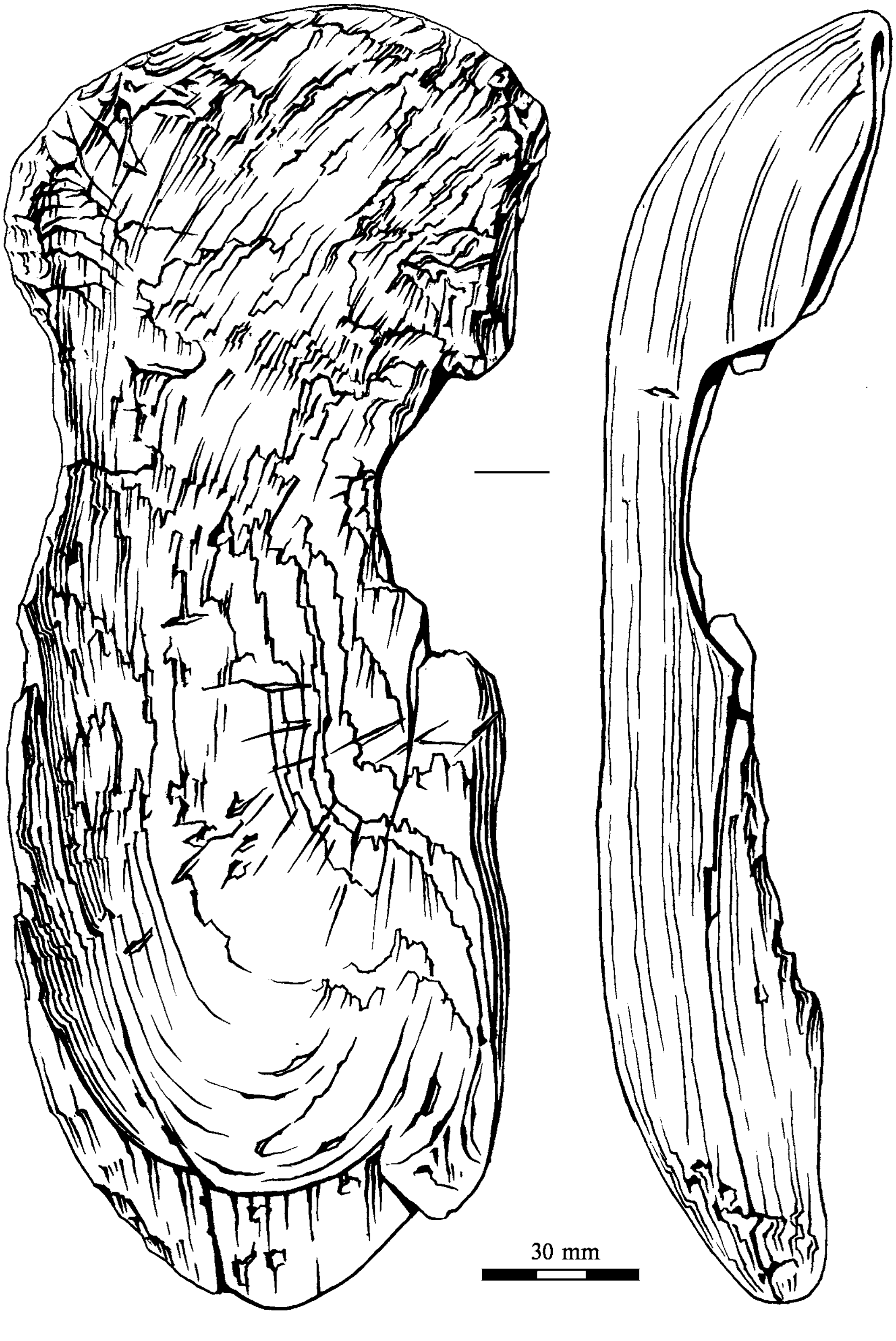


**Figure 53. Wooden artifact from the Zhokhov Island site. Household equipment (burnt bowl).**


**Figure 54. Wooden artifact from the Zhokhov Island site. Household equipment (scoop).**

**Figure 55. Wooden artifact from the Zhokhov Island site at the beginning of excavations in 1990.**

**Figure 56. Two months later, before finishing.**

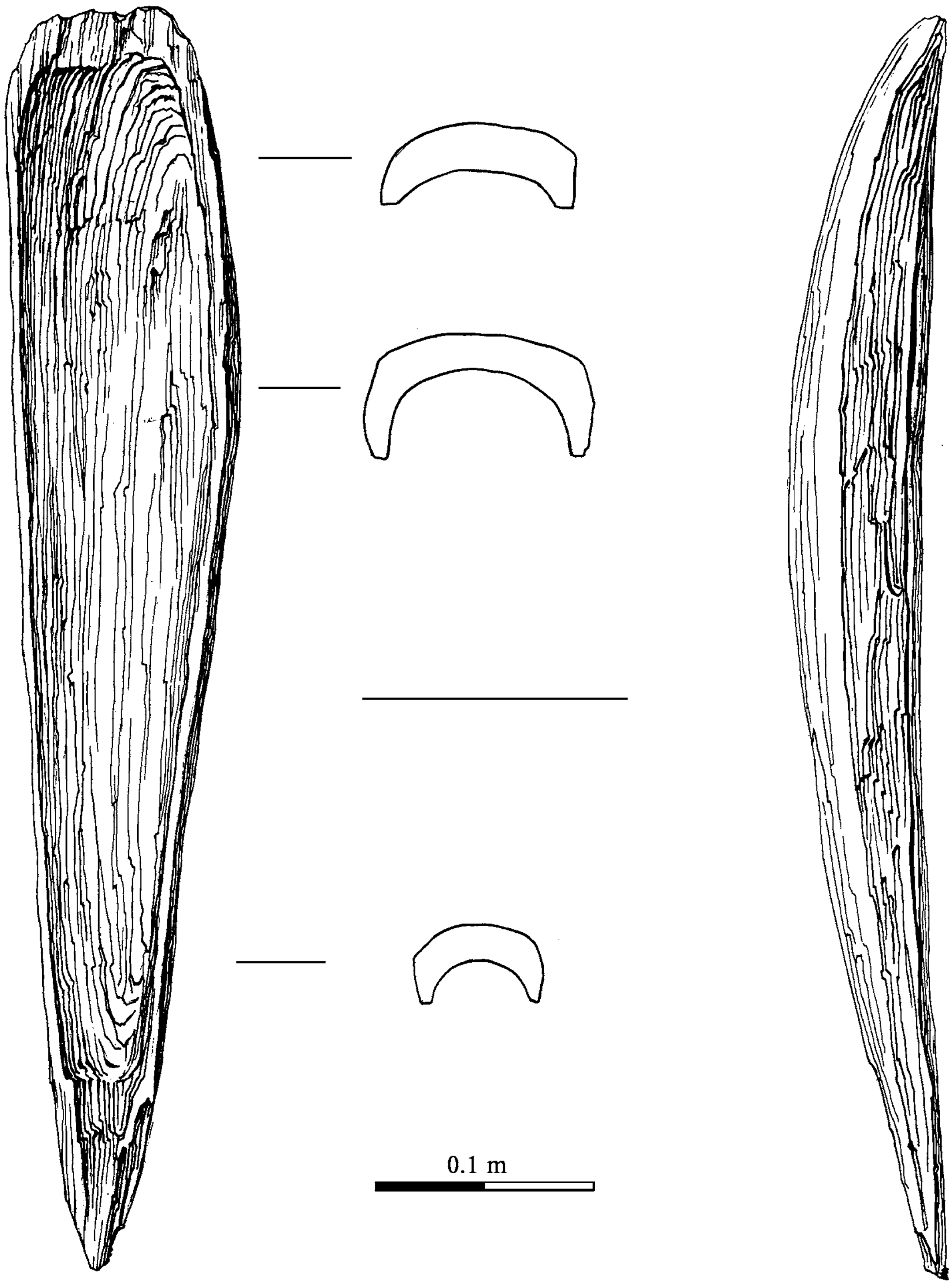


**Figure 57. Wooden artifact from the Zhokhov Island site (a large scoop shown in pictures 55 and 56).**

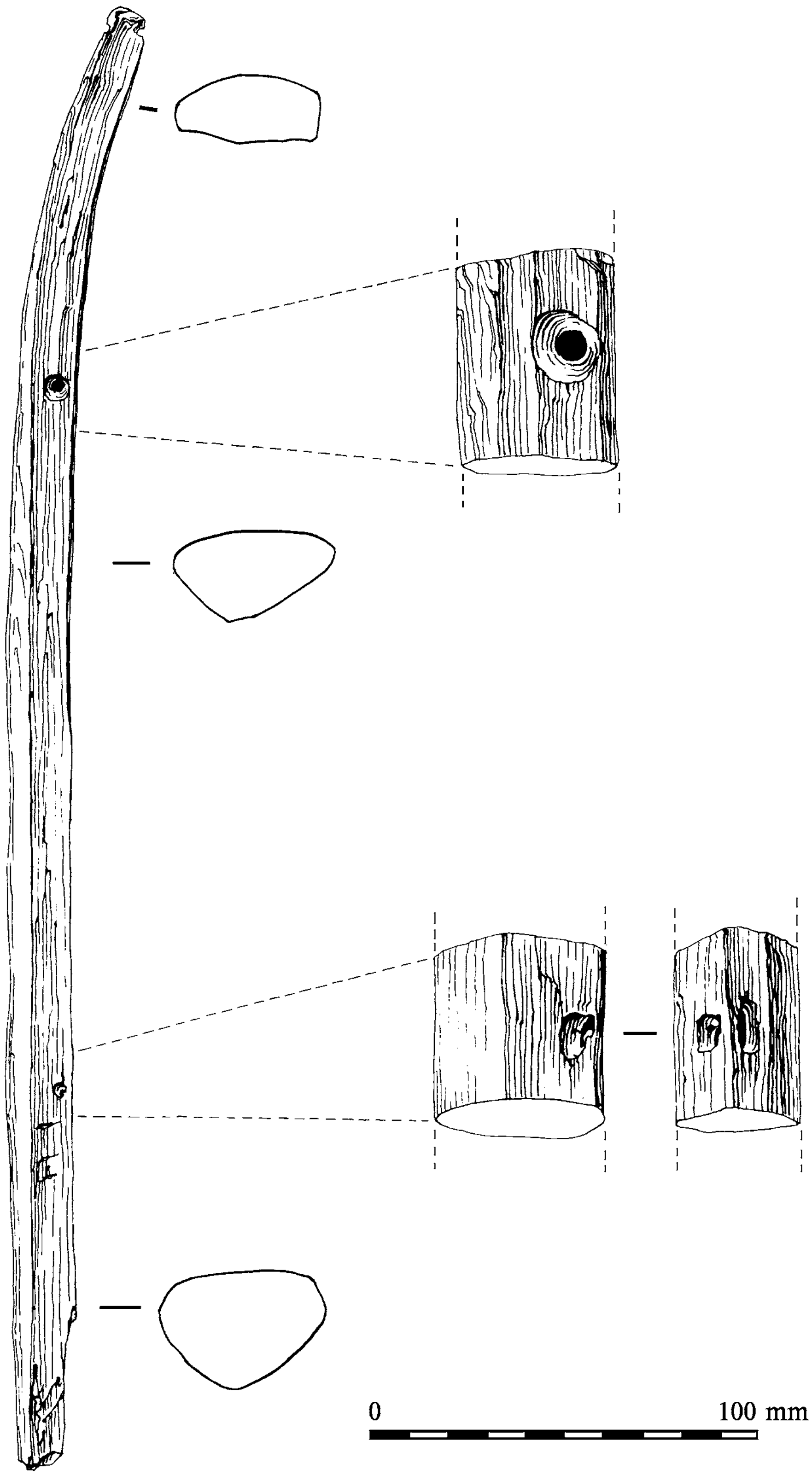


**Figure 58. Sledge runner from the Zhokhov Island site.**

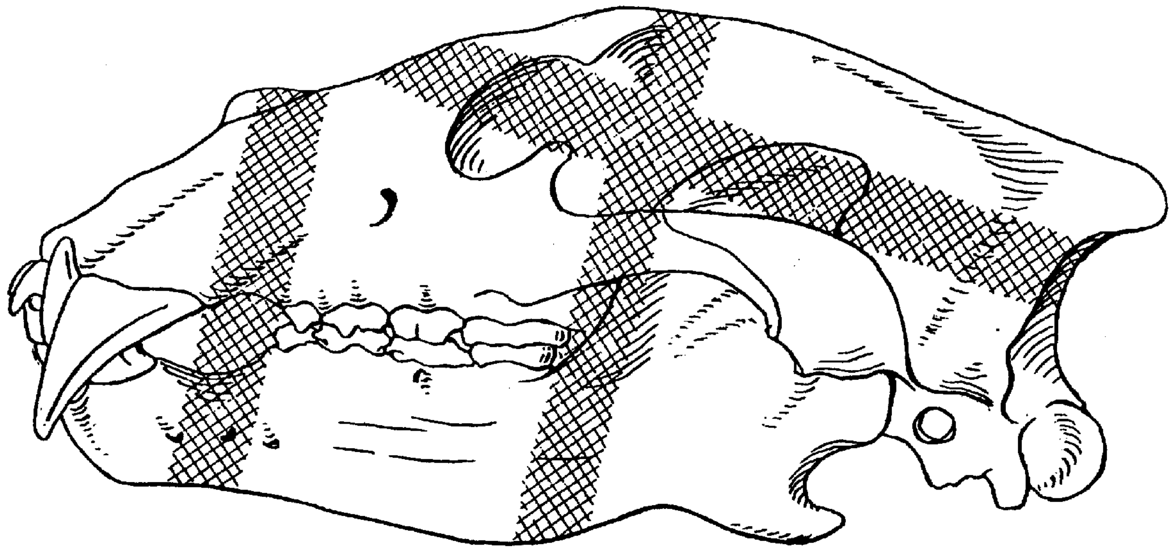

**Figure 59. Scheme of the fracturing of polar bear skulls. Totally crushed zones are cross-shaded (after Pitul'ko and Kasparov 1996).**

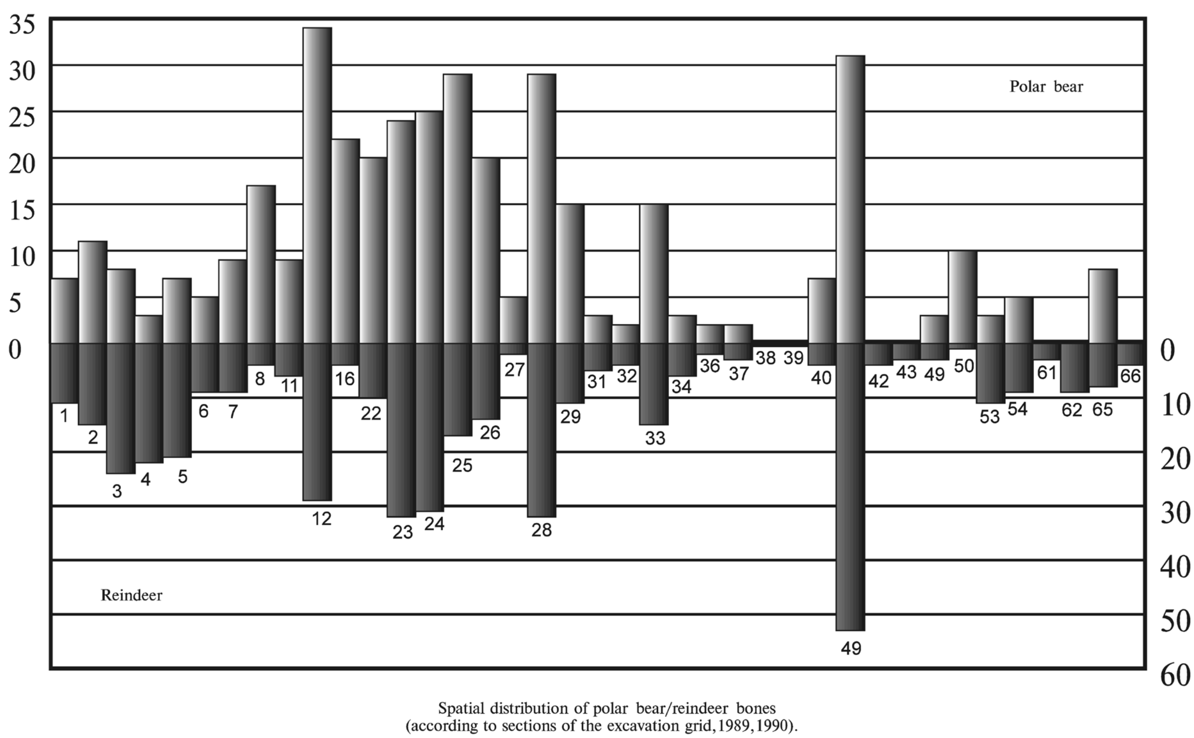


**Figure 60. Spatial distribution of polar bear and reindeer bones, according to sections of the excavation grid (after Pitul'ko and Kasparov 1996).**

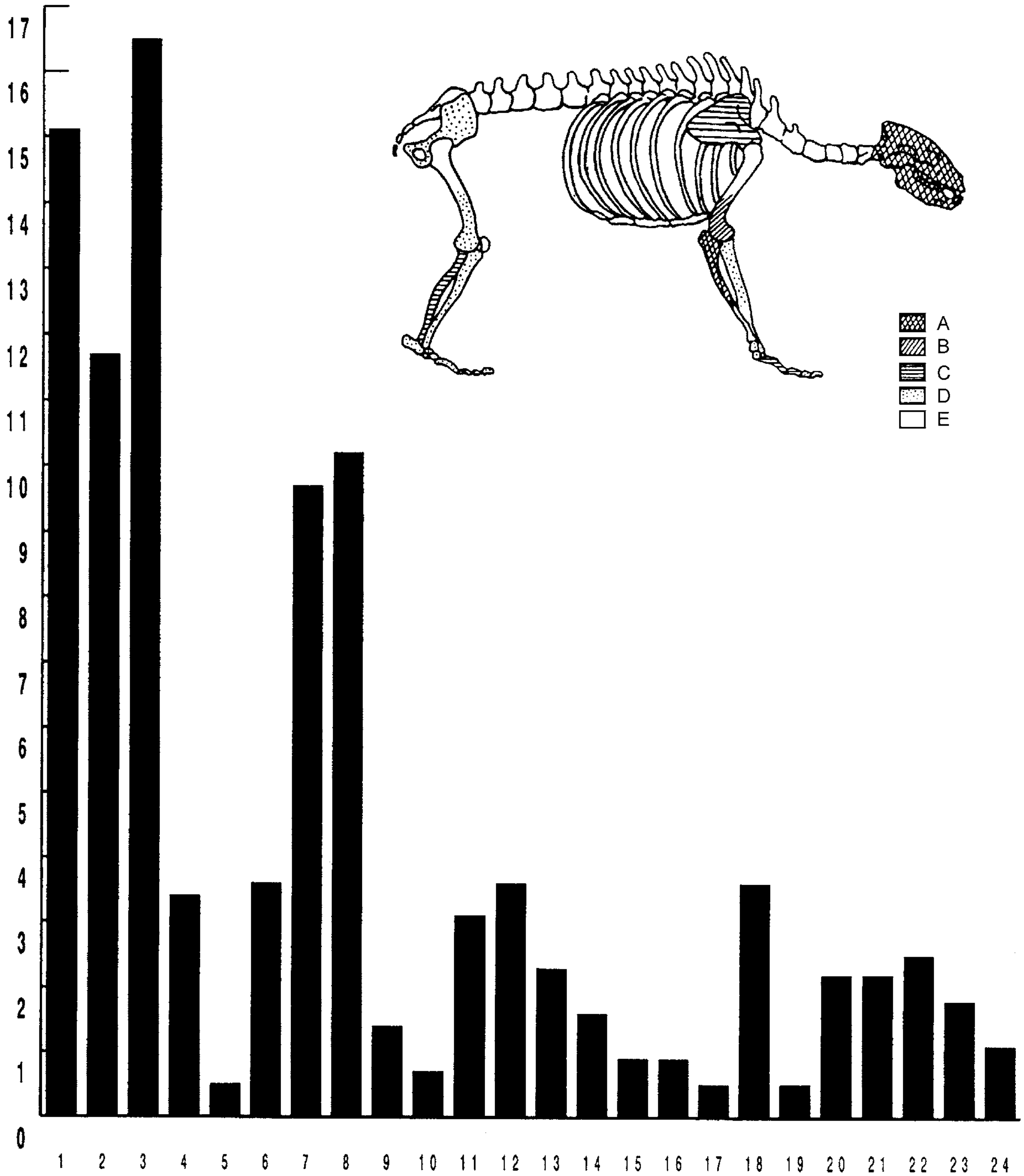


**Figure 61. Range of skeletal remains of polar bears: (A) more than 10%; (B) from 5 to 10%; (C) from 3 to 5%; (D) less than 0.5%, (E) (empty) not found; general (graph) and specified percentage (diagram): (1) skull fragments (15.1%); (2) fragments of mandibles (11.7%); (3) teeth found separately from the jaws (16.5%); (4) atlases (3.4%); (5) axis (0.5%); (6) shoulder blades (3.6%); (7) distal humerus (9.7%); (8) ulnae (10.2%); (9) fragments of radius (17.4%); (10) carpal bones (0.7%); (11) metacarpal bones (3.1%); (12) phalanges I (forelegs, 3.6%); (13) phalanges II (forelegs, 2.3%); (14) claw phalanges (forelegs, 1.6%); (15) pelvis (0.9%); (16) distal femur (0.9%); (17) tibiae (0.5%); (18) fibulae (3.6%); (19) ankle bones (0.5%); (20) phalanges I (hind legs, 2.5%); (21) phalanges II (hind legs, 1.8%); (22) claw phalanges, hind legs (1.1%) (after Pitul'ko and Kasparov 1996).**

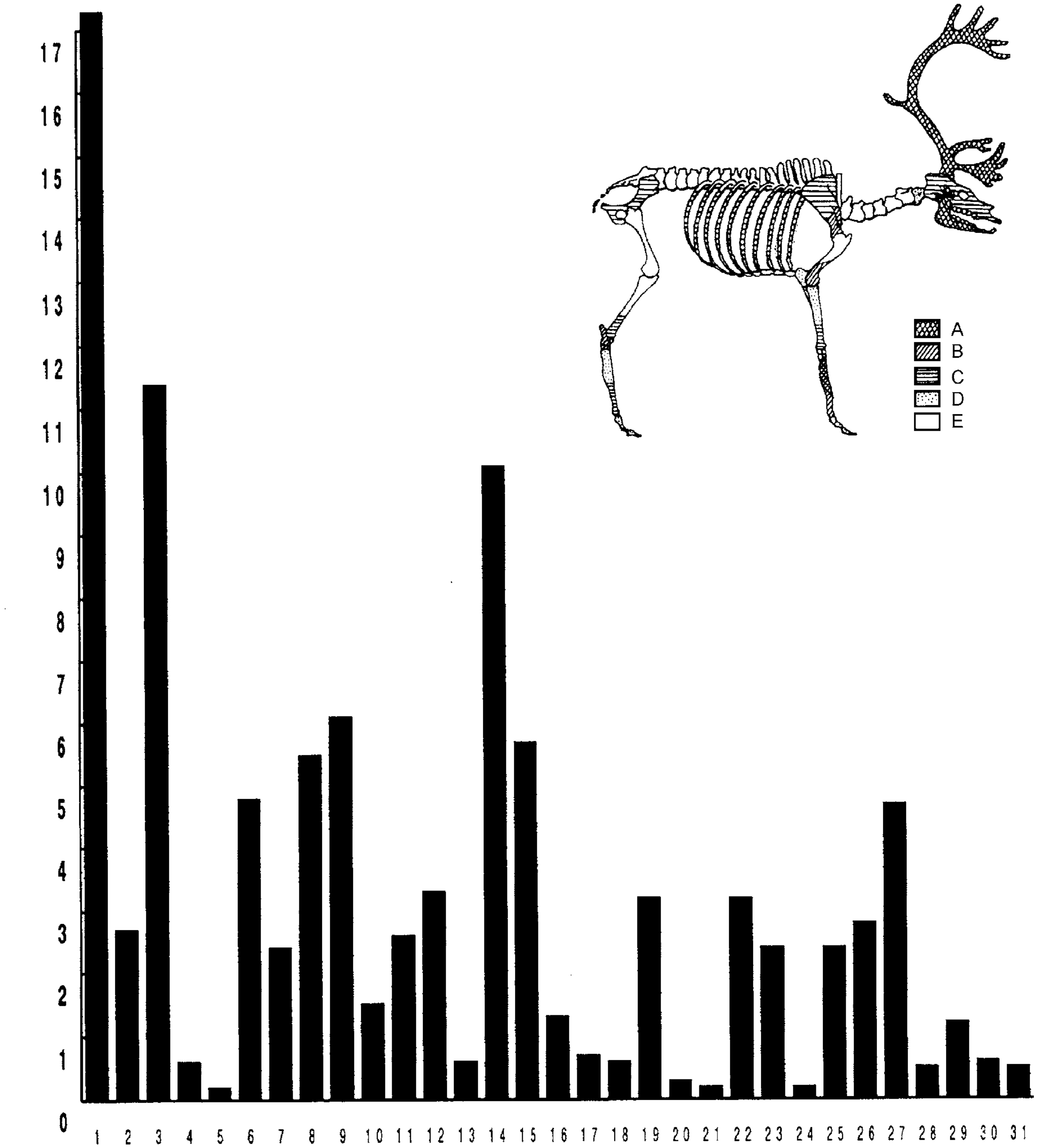


**Figure 62. Range of skeletal remains of reindeer: (A) more than 10%; (B) from 5 to 10%; (C) from 3 to 5%; (D) less than 0.5%; (E) (empty) not found; general (graph) and specified percentage (diagram): (1) skull fragments (2.7%); (2) fragments of mandibles (11.4%); (3) atlases (0.6%); (4) axis (0.2%); (5) ribs (4.8%); (6) shoulder blades, fore sections (2.4%); (8) shoulder blades, rear sections (2.4%); (9) distal humerus (6.1%); (10) ulnae (1.5%); (11) proximal radius (2.6%); (12) distal radius (3.3%); (13) carpal bones (0.6); (14) proximal metacarpals (10.1%); (15) distal metacarpals (5.7%); (16) phalanges I (forelegs, 1.3%); (17) phalanges II (forelegs, 0.7%); (18) hoof phalanges (forelegs, 0.6%); (19) pelvis (3.2%); (20) proximal femur (0.3%); (21) distal femur (0.2%); (22) distal tibiae (3.2%); (23) ankle bones (2.4%); (24) heel bones, rear sections (0.2%); (25) heel bones, fore sections (2.4%); (26) proximal metatarsals (2.8%); (27) distal metatarsals (4.7%); (28) central carpal bone (0.5%); (29) phalanges I (hind legs, 1.2%); (30) phalanges II (hind legs, 0.6%); (31) hoof phalanges, hind legs (0.5%) (after Pitul'ko and Kasparov 1996).**

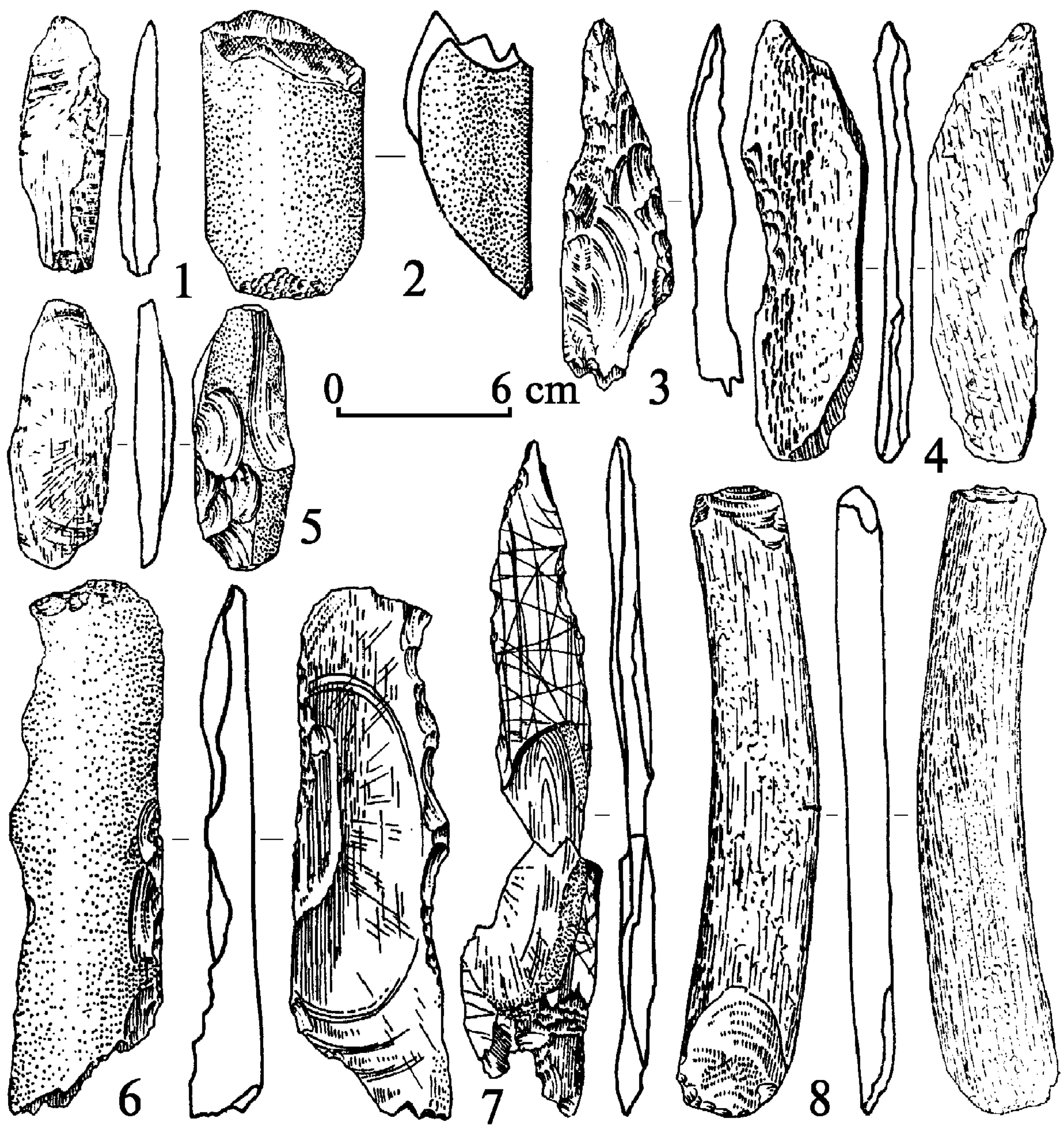


**Figure 63. Worked bones (1, 2, 4, 5, and 8) and mammoth ivory (3, 6, and 7) from the Late Upper Paleolithic Berelekh site, downstream of Indighirka River (after Y. A. Mochanov, 1977).**

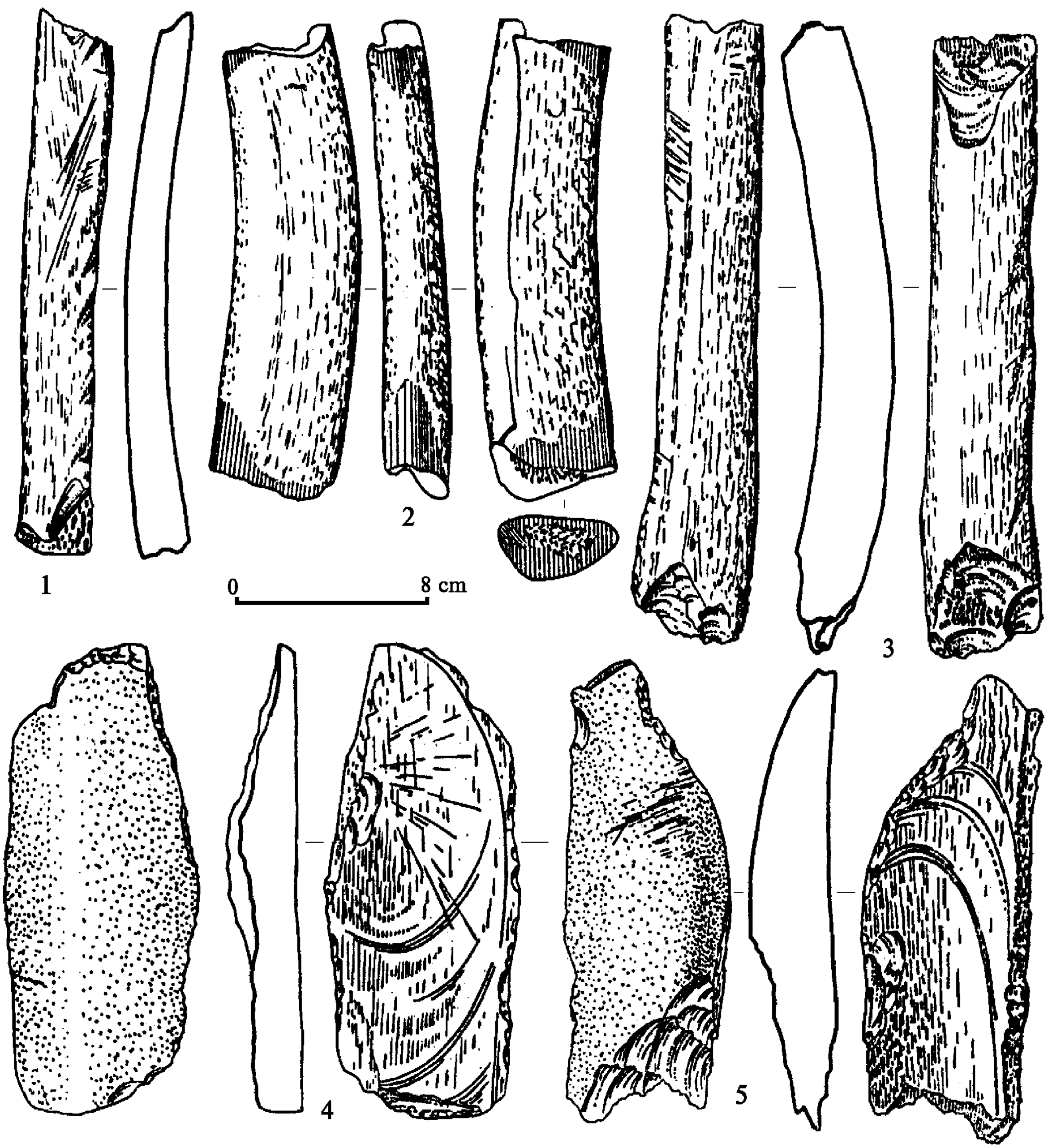


**Figure 64. Worked bones (1–3) and mammoth ivory flakes (4, 5) from the Late Upper Paleolithic Berelekh site, downstream of Indighirka River (after Y. A. Mochanov, 1977).**

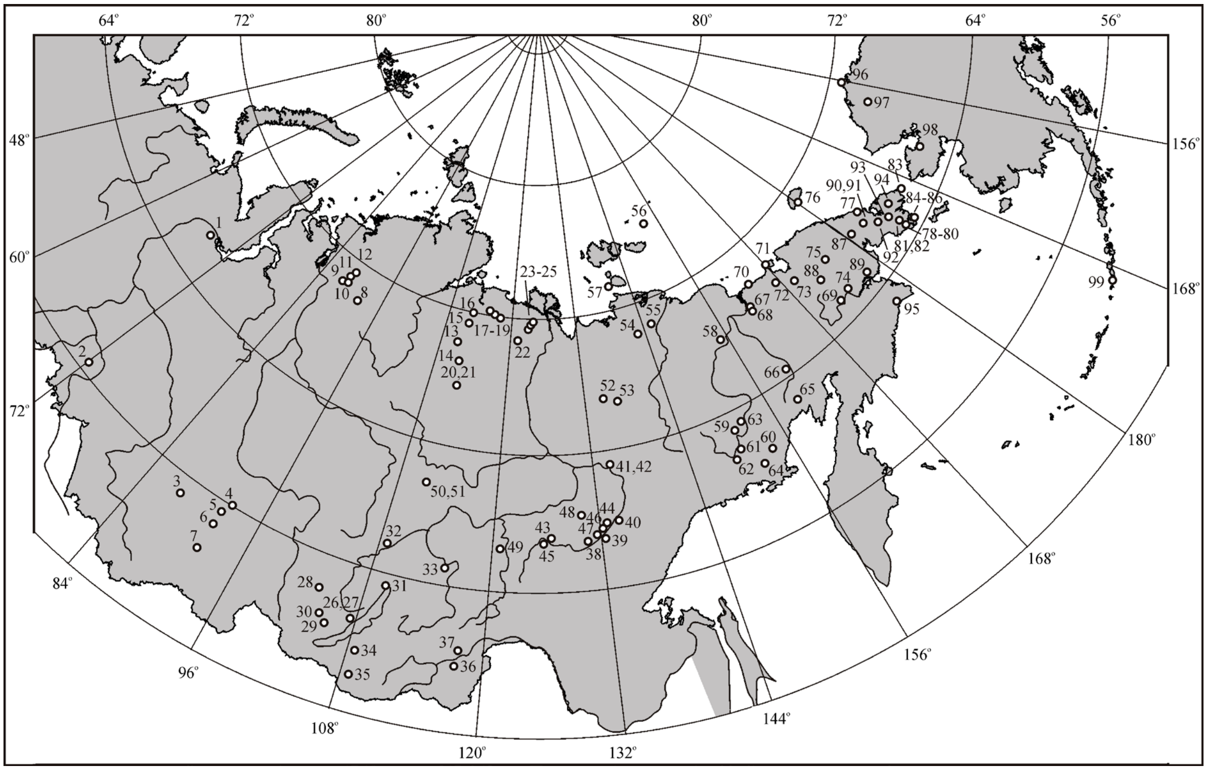


**Figure 65. Siberian, Alaskan, and Aleutian archaeological sites mentioned in the text: 1 - Korchagi I-B; 2 - Chernoozerie II; 3 – Berezovyi ruchey; 4 – Afontova Gora; 5 – Birusa; 6 – Kokorevo I; 7 – Maininskaya; 8 - Tagenar VI; 9 - Lantoshka II; 10 - Pyasina I, II, III, IV, V, IX, XV; 11 – Malaya Korennaya II, III; 12 - Kapkannaya II; 13 - Staraya II; 14 - Delingde II, III, IV; 15 – Chuostakh-Yuryuge; 16 – Yakutskiy Tyubelyakh; 17 – Berelekh-Ayan; 18 – Bayan; 19 – Ulakhan-Kyuel-Seene; 20 – Ochuguy-Manyngda; 21 – Olenyok I; 22- Nizhne-Taloudskaya; 23 – Khotuguy-Neiuo; 24 - 255 km I, II; 25 - Khorbusuonka I; 26 – Ityrkhey; 27 – Sagan-Nuge; 28 – Gorelyi Les; 29 – Verkholenskaya Gora; 30 – Ust-Belaya; 31 – Kurla; 32 – Chastinskaya; 33 – Staryi Vitim; 34 – Oshurkovo; 35 – Studyonoye; 36 – Shilkinskaya Peschera; 37 – Mogilnik Molodovsk; 38 - Belkachi I; 39 – Dyuktayskya Peschera; 40 – Verkhne-Troitskaya; 41 - Ikhine I; 42 - Ikhine II; 43 – Sumnagin I; 44 – Ust-Mil II; 45 – Ust-Timpton; 46 – Bilir; 47 – Syurakh-Ary; 48 – Oniesskoye; 49 – Dzhikimdinskoye; 50 – Mogilnik Tuoy-Khaya; 51 - Tuoy-Khaya; 52 – Kuranakh I; 53 – Adycha; 54 – Berelyokh; 55 – Chokurdakh; 56 – Zhokhov Site; 57 – Kigilyakh; 58 – Bochanut; 59 – Mayorych; 60 - Buyunda III; 61 – Kongo; 62 – Siberdik; 63 – Seymchan; 64 – Kheta; 65 – Druchak-Vetrenyi; 66 – Bolshoy Elgakhchan I; 67 – Rodinkskoye Pogrebenie; 68 - Penteleikha I-VIII, Pirs; 69 – Vakarevo; 70 – Mys Bolshoy Baranov; 71 – Ryveem; 72 - Rauchuagytgyn I; 73 - Tytyl IV; 74 – Ust-Belskiy Mogilnik; 75 – Ozero Chirovoe; 76 – Chortov Ovrag; 77 – Vankarem; 78 - Kurupka I; 79 - Chaatamie I; 80 – Achen; 81 - Chelkun IV; 82 – Ananayveem; 83 – Naukan; 84 – Puturak; 85 - Itkhat IB; 86 – Ulkhum; 87 – Yakitikiveem; 88 – Elgygytgyn; 89 – Kanchalan; 90 – Kymyneykey; 91 – Mys Bezymyannyi; 92 - Kymynanovyvaam VII, VIII, XIV; 93 - Ioniveem VII; 94 - Igelkhveem XVI; 95 - Ineskvaam I; 96 – Walakpa; 97 – Gallagher Flint Station; 98 - Trail Creek; 99 – Anangula.**

# ABBREVIATIONS

| | |
|---|---|
| AANII | Arkticheskii i Antarkticheskii nauchno-issledovatel'skii institut [Arctic and Antarctic Science Research Institute]. |
| ADD | Avtoreferat dissertatsii na soiskanie uchenoi stepeni doktora nauk [Abstract of the dissertation submitted for the scholarly degree of doctor of sciences]. |
| AIChPE | Assotsiatsiya po izucheniyu chetvertichnogo perioda v Evrope [Association for the Study of the Quaternary Period in Europe]. |
| AKD | Avtoreferat dissertatsii na soiskanie uchenoi stepeni kandidata nauk [Abstract of the dissertation submitted for the scholarly degree of candidate of sciences]. |
| AN SSSR | Akademii nauk Soyuza Sovietskikh Sotsialisticheskikh Respublik [Russian Academy of Sciences Union of Soviet Socialist Republics]. |
| ANII | Arkticheskii nauchno-issledovatel'skii institut [Arctic Science Research Institute]. |
| AO | Arkheologicheskie otkrytiya [Archaeological Discoveries]. |
| BKIChP | Byulleten' Komissii po izucheniyu chetvertichnogo perioda [Bulletin of the Commission for the Study of the Quaternary]. |
| BKNII | Buryatskii kompleksnyi nauchno-issledovatel'skii institut [Buryat Interdisciplinary Science Research Institute]. |
| DAN SSSR | Doklady Akademii nauk SSSR [Reports of the Academy of Sciences, USSR]. |
| GUGK | Glavnoe upravlenie geodezii i kartografii [Chief Administration of Geodesy and Cartography]. |
| IA RAN | Institut arkheologii Russkoi Akademii nauk [Russian Academy of Sciences]. |
| IIMK RAN | Institut istorii material'noi kul'tury Rossiiskoi Akademii nauk [Institute for the History of Material Culture of the Academy of Sciences]. |
| IRGO | Imperatorskoe Russkoe geograficheskoe obshchestva [Imperial Russian Geographic Society]. |
| IVGO | Izvestiya Vsesoyuznogo geograficheskogo obshchestva [Bulletin of the All-Union Geographic Society]. |
| IVSORGO | Izvestiya Vostochno-Sibirskogo otdeleniya Russkogo geograficheskogo obshchestva [Bulletin of the East Siberian Division of the Russian Geographic Society]. |
| KIChP | Komissiya po izucheniyu chetvertichnogo perioda [Commission for the Study of the Quaternary]. |
| KSIA | Kratkie soobshcheniya Instituta arkheologii [Brief Reports of the Institute of Archaeology]. |
| KSIIMK | Kratkie soobshcheniya Instituta istorii material'noi kul'tury [Brief Reports of the Institute of the History of Material Culture]. |

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| MAESV | Materialy po arkheologii Evropeiskogo Severo-Vostoka [Materials on the Archaeology of the European Northeast]. |
| MGI | Materialy glyatsiologicheskikh issledovanii [Materials on Glacial Research]. |
| MGU | Moskovskii gosudarstvennyi universitet [Moscow State University]. |
| MIA | Materialy i issledovaniya po arkheologii SSSR [Materials and Investigations of the Archaeology of the USSR]. |
| RA | Rossiiskaya arkheologiya [Russian Archaeology]. |
| SA | Sovetskaya arkheologiya [Soviet Archaeology]. |
| SAI | Svod arkheologicheskikh istochnikov [Fund of Archaeological Sources]. |
| SAS | Sibirskii arkheologicheskii sbornik [Siberian Archaeological Collection]. |
| SE | Sovetskaya etnografiya [Soviet Ethnography]. |
| SPbGU | Sankt-Peterburgskii gosudarstvennyi universitet [St. Petersburg State University]. |
| SVKNII DVNTs | Severo-Vostochnyi kompleksnyi nauchno-issledovatel'skii institut Dal'nevostochnogo nauchnogo tsentra [Northeastern Interdisciplinary Scientific Research Institute of the Far East Science Center]. |
| TD KPKIKN | Tezisy dokladov konferentsii "Problemy kul'turogeneza i kul'turnogo naslediya." Tyumen'. 7–10. XII. 1993 [Summary of Reports from the Conference "Problems of Cultural Genesis and Cultural Legacy."Tyumen', 7–10. XII. 1993]. |
| TD MK | Tezisy dokladov mezhdunarodnoi konferentsii [Summary of Reports from the International Conference]. |
| TD NTK | Tezisy dokladov nauchno-teoreticheskoi konferentsii [Summary of Reports from Theoretical Science Conference]. |
| TD VS | Tezisy dokladov Vsesoyuznogo soveshchaniya [Summary of Reports from the All-Union Conference]. |
| TIE | Trudy Instituta etnografii AN SSSR [Works of the Institute of Ethnography, Academy of Sciences, USSR[. |
| UzPGU | Uchenye zapiski Permskogo gosudarstvennogo universiteta [Scholarly Notes of Perm State University]. |
| VGO | Vsesoyuznoe geograficheskoe obshchestvo [All-Union Geographic Society]. |
| VINITI | Vsesoyuznyi institut nauchnoi i tekhnicheskoi informatsii [All-Union Institute of Scientific and Technical Information]. |
| VSEGEI | Vsesoyuznyi geologicheskii institut [All-Union Geological Institute]. |
| ZIN | Zoologicheskii institut Akademii nauk [Zoological Institute of the Academy of Sciences]. |
| ZMAI | Zapiski Moskovskogo arkheologicheskogo instituta [Notes of the Moscow Archaeological Institute]. |
| ZZh | Zoologicheskii zhurnal [Zoological Journal]. |