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, Isayeva and others) 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, 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, Makeyev, 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, A.A. 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 abovementioned 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 50,000–55,000 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 9600–10,000 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-high exposure at 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 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, is is one of the northernmost Palaeolithic sites in Eurasia. It 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, Golikov, Danilov and 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 Palaeolithic 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 Palaeolithic 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 Palaeolithic 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.