Chapter 1
The Dynamics of the Eurasian Steppe Ecology

And let us keep in mind the original fragility of man in the face of the colossal forces of Nature.

F. Braudel, The Structures of Everyday Life

The role of the environment in the history of human communities was evaluated even in ancient times: Hippocrates (c. 460–c. 370 B.C.), in his tract *On Air, Waters, and Places,* advanced an idea about the influence of geographical factors and climate on the human physical constitution and personality and on human social systems. The French Encyclopedist Montesquieu, regarded as the founder of the Geographic School, held that landscape, soil, and climate determined the spirit of a people and the character of their social development. The French sociologists of the Geographic School contributed a great deal to the substantiation of the role of geographical factors in the cultural development of peoples of different regions. However, Soviet science rejected the environmental determinism of the German school of geopolitics due to its use in Nazi doctrine, which caused the whole idea to be discredited for a long time, particularly among Soviet scientists. There the determining factor in history was understood to be not the regular laws of interaction between man and Nature, but the succession of production modes as a result of class struggle (Fedorov 1972).

However, a new modeling of the world system, carried out by the Club of Rome in the 1970s, revealed a pessimistic forecast resulting from ecological processes. It showed that the threshold of the biosphere's stability had been disturbed several times, threatening a global catastrophe in the immediate future, and this stimulated a worldwide boom in the study of ecology.

The notion of "ecology" as it applied to zoology was introduced as early as the nineteenth century by E. Haeckel, and in the mid-twentieth century it was established as a scientific study of the general laws of the

system of all the components of the biosphere, including man. In recent years, Russian science after Yu. Odum (1975) has shown an increasing interest in this issue (*Obshchestvo i prirodnaya sreda* 1980; Depenchuk, Krisachenko 1987; Balandin, Bondarev 1988; Rakhilin 1989; and so on).

The historians of the French Annales School attach great importance to ecological issues. F. Braudel (1949, 21) wrote that "the history of people is in their close interrelation with the earth, which they tread and feed on, the history of a continuous dialogue of man and Nature which determines global processes of slow time." He assigned a significant role to the study of unstable but long-term periods of equilibrium between man, climate, and soil, and spoke about the climatic rhythms and the demographic processes which determine the potentials and limits of the evolution of civilization.

In the late nineteenth and early twentieth centuries, European and American scholars, first in geography and then in sociology, introduced the notion of "human ecology," demonstrating that man, like other biological species of the planet, not only influences the environment, but also is affected by it.

The most comprehensive expression of the ecological approach to history is given in American researcher L. White's comparative culturology (1959). His notion is based on the idea of cultural evolution as an extrasomatic adaptation of human communities to environmental influence. Regarding culture as an objective category, White identified its three components: technological, social, and ideological. Using Charles Darwin's ideas on evolution, White sets forth a model for cultural evolution that suggests that overcoming a crisis is a stimulus to cultural innovation. An important place in White's conception belongs to the humanistic ideas of cultural relativism, which acknowledges biological equality, the equal prospect of each ethnic culture to develop independently, giving grounds for the comparative culturological analysis of human cultures on both a synchronic and diachronic [redacted]sis.

Criticism of White's conception in terms of orthodox Marxism is [redacted]nconvincing (Murav'ev 1988; Viktorova 1989). His ideas have been accepted by many American scholars and form the basis of the explanations of L. Binford, K. Flannery, and others of the causes and character of the Neolithic revolution (Flannery 1965; Shnirelman 1978).

White's conception also influenced a number of leading Russian researchers. One should mention, first of all, culturologist Eh. S. Markaryan (1973; 1981). Notwithstanding his bitter criticism of White's views, he accepted, and took as a basis of his own conception, White's main thesis, according to which cultures adapt to environmental conditions, ensuring the survival of mankind. This tenet lies at the heart of Markaryan's system analysis of cultural evolution.

White's influence is felt also in the works of S. A. Arutyunov (1989), T. I. Alekseeva (1986), and, particularly, V. P. Alekseev (1971; 1984; 1993), who substantiated the meaning of the ecological approach not only to human biological evolution but also to human social development. He emphasized the role of natural selection in the process of adaptation and introduced the notion of "anthropogeocenosis." Evaluating White's theory, Alekseev acknowledged that "the conception of cultural relativism can now claim the central place in examining and assessing the cultural diversity of mankind both in our time and in its historical evolution" (1993, 105).

Ethnicity is defined as the totality of interrelated mechanisms and modes of human activity handed down from generation to generation, extra-biologically worked out, and aimed at the adaptation to a certain ecological niche, in order to reproduce the ethnic community (Kuzmina 1994c, 50). It is the reduction of food resources that compelled people to change their area of residence or to look for new economic methods of production to ensure their survival.

The ecological approach suggests that we need to reconstruct not only the history of human economic activity but also the dynamics of the environment, including the character and productivity of the soil, landscape, flora, fauna, and climate, any alteration in which leads to a change in the whole ecological system. The challenge is to analyze comprehensively the paleogeographical, paleobotanical, paleozoological, and archaeological data.

The Eurasian Steppe is a unique ecological system. (Maps 2, 3, 4; Figs. 1, 2). From west to east it stretches for 8,500 km, from the Danube to the Great Wall of China. From north to south it extends for 400–600 km, from the forest and forest-steppe zone in the north to the zone of foothills, semidesert, and desert in the south, and between 58° and 47° latitude north of the equator (Mordkovich 1982, 19, 25; Dinnesman 1977). The principal characteristic—and the cause of the formation—of the Steppe landscape is the continentality of climate and the deficiency of moisture (less than 500 mm of annual precipitation), which dictates the vegetation of the Steppe ecosystems. The prevailing vegetation is thus narrow-leaved drought-resistant grasses with well-developed root systems. Annual overdecay of plants leads to the formation of soils rich in humus (up to 700 tons per hectare [t/ha]). The character of vegetation and climate also determines the fauna of the Steppe. Herbivores prevail, with ungulates alongside underground residents like gophers and marmots.

The natural conditions of the Steppe are nevertheless quite diverse (Fig. 3). The Steppe of the Danube Region and the Azov Sea Littoral, with its even surfaces and extremely rich black earth, differs considerably from the semidesert of Ryn-Sands in the Caspian Sea Littoral, from the hillocky area of Central Kazakhstan (Sary-Arka) with its hilly relief, fluvial valleys rich in vegetation, and bare hills, from the Siberian Steppe bordering on the pine forests and taiga on the north and on the Altai and Sayan Mountains in the south, and, finally, from Xinjiang, where the Steppe is side-by-side with oases, severe deserts, and highlands (Mordkovich 1982; M. P. Petrov 1964; 1966; Murzaev 1990).

A distinguishing feature of the steppe zone being moisture deficiency, the southern areas are actually six times drier than the northern ones. The amount of annual precipitation varies from 600 mm in the north to 150 mm in the south. Between 75% and 85% of the moisture evaporates. The rate of evaporation is much higher in the south than in the north, and the total precipitation in the south in winter is half as great as in the north.

Due to the unstable character of the moisture supply, the Steppe ecosystem belongs to an unstable farming zone, in the east continentality being more pronounced than in the west, because of the influence of the Siberian anticyclone. At the same time, while the Steppe vegetation is rich and diverse, it is also essentially heterogeneous. The phytomass reserves are richest in the center of the feather-grass–multiherbaceous part of the Steppe zone, while in the west they reach the maximum figure of 48 t/ha, and at the boundary with the forest-steppe, with its goosefoot vegetation, this figure falls to 28 t/ha. In the wormwood–sheep-fescue Steppe of the southern zone, it drops to 9 t/ha (Mordkovich 1982; Kotova 1994, 771).

Depending on the cyclical fluctuations of the climate and the degree of humidity related to them, the latitudinal bounds and the character of the flora and fauna of the Steppe sometimes changed in the course of the Quaternary period. In the more humid epochs, meadow vegetation became widespread, the processes of humus layer formation intensified, and the Steppe zone shifted considerably southward.

The reconstruction of the Eurasian paleoclimate was worked out in 1910 by Blytt and Serander on the basis of paleobotanical analysis of pollen from Scandinavian peat bogs. They established that, in the course of the Holocene, the post-glacial period of the Quaternary, there were several stages of warming (xerotherm) and cooling, and wet and dry periods. Later this scheme was used as a pattern for other regions of the world (Bruks 1952; Predtechensky 1957; Maksimov 1972; Borisov 1975; Buchinsky 1979; Mokin, Shishkov 1979; Budyko

1970; Budyko, Golitsyn, Izrael' 1986; Poltaraus, Kislov 1986; Veklich 1987; Gerasimov 1993). Climate change could be traced on a global scale. From Western Europe to China, there are correlations of temperature and moisture changes (Lamb 1982; Shaomin Lin 1982; Bradley 1989; Hsü 1998).

The post-glacial period was marked by a gradual rise of temperature, which reached its peak in the fifth to fourth millennia B.C.; along the middle latitudes of Eurasia this resulted in favorable circumstances—humidity rose and the annual temperature was almost three degrees higher than presently. There was a period of gradual cooling that reached its maximum peak around the year 2000 B.C. That was followed by a period of warming, and in the ninth–seventh centuries there was a cooling trend again, with its peak in the ninth century B.C. Events precipitated by this last cooling trend were reported in some Greek and Chinese written sources.

Some of these climatic fluctuations continued to occur throughout Eurasia, but at different rates. The climatic situation in various regions changed, essentially depending on such local factors as air currents, changes in the water table, the formation of lakes and their biological development, or swamping as studied by limnology (Krasheninnikov 1951; Shnitnikov 1957a, b; Dzen-Litovsky 1957; Bogoslovsky 1960; Liss, Berezina 1982), and fluctuations in the levels of the Caspian, Aral, and Black seas (Fedorov 1957; Samsonov 1963; Shnitnikov 1961; Kes' 1969).

Palynological studies and the application of radiocarbon dating methods gave scientists an opportunity to test the Blytt–Sernander scheme, reconstructing the changes in vegetation and climate in the Central Russian Plain (Neishtadt 1957; 1965) and in northern Eurasia (Bruks 1952, Khotinsky 1977; 1980; 1982). The Steppe occupies an intermediate position between the Atlantic-continental zone of the Russian Plain and the continental zone of Siberia. N. A. Khotinsky elaborated a scheme of climatic changes in the Holocene in Eurasia. In the post-glacial period, there was a rise of temperature and humidity. The Boreal period between the years 6900 and 6300 B.C. was characterized by high temperatures accompanied by low precipitation in the Russian Plain and by considerable humidity in Siberia. In the Atlantic period, between the years 4000 and 3000 B.C., and in the Subboreal period, the climate of the Russian Plain was more humid, while in Siberia, on the contrary, a decrease in precipitation occurred.

But the climatic regularities established for northern Eurasia, as mentioned before, cannot be assumed to be the same for the Steppe. Furthermore, the chronological framework is open to dispute. Finally, correlations between the palynological record and the archaeological strata remain problematic.

A. V. Shnitnikov's perspectives on climate (1957a, b; 1961; 1969), suggesting that cycles of climatic fluctuations lasted about 1,800 years, has been widely accepted in Russian scholarship. However, his scheme rests to a great extent on the studies of the Khorezm Expedition. These correlations between palynology and archaeological strata have since been reevaluated, and therefore this formulation has been questioned (Itina 1977, 32–35).

Unfortunately, we do not have conclusive evidence for the climatic and geographical changes in the Eurasian Steppe and the contiguous territories during the Holocene. There is disagreement not only among various disciplines such as paleobotany, paleozoology, soil science, and limnology—but within each specialty as well.

This state of affairs is exemplified by contradictory conclusions about periods of the expansion of the Caspian Sea (where chronological differences between schemes proposed by N. V. Fedorov and other researchers show discrepancies of as much as two thousand years). The Central Asian climate in the sixth to third millennium B.C., according to G. N. Lisitsyna (1972), shows no changes in the lowland plain of Turkmenistan, whereas the data of S. K. Samsonov (1963), A. V. Vinogradov (1975; 1981), and E. M. Mamedov (Vinogradov, Mamedov 1975) indicate that this was the time of the Lyavlyakan pluvial, when the Kyzyl Kum Desert was a system of bogs and lakes, with bountiful fish species that constituted the basic diet of the Kelteminaric people, who lived in the region between the Caspian and Aral seas.

The actual time period when the modern steppe and desert landscapes of Central Asia came into being is also disputed. According to the data of A. L. Yanshin (1961) and A. A. Kurkov (1969), these landscapes are ancient. Other researchers, however, believe that the development of the present-day arid landscapes date to the Holocene, and, according to a number of authors, specifically to around the year 3000 B.C. (Gerasimov 1937; 1956; Kassin 1947; 1949).

Some researchers believe that the boundary of the Steppe and the forest-steppe in the north, and the boundary of the semideserts in the south were stable (Neishtadt 1965, 198–99), while others assert the opposite (Mil'kov 1953; 1967; Shuvalov 1966; Vasilyukhina 1969; Zubakov 1972; Mordkovich 1982; Volkova, Levina 1982).

The serious disagreements among researchers center around the absolute chronology of the Atlantic and Subboreal epochs and the period when the warming occurred within the Subboreal epoch. Here the discrepancies vary from several centuries to millennia. The data from different disciplines also conflict, especially during the critical period of the late second to early first millennium B.C. The soil scientists, for example, conclude that the climate in northern Kazakhstan "can be reconstructed as dry and more continental. The natural zone boundaries shifted to the north by approximately 250 km, i.e., by one zone" (Khabdulina, Zdanovich 1984, 145, 153), whereas the topographic data from archaeological sites indicate that there was "a stage of warming and moisture" as "a result of more rainfall and a rise in water table" (Potemkina 1985, 25, 28).

Assessment of these disputes is beyond the expertise of archaeology. Therefore multidisciplinary research with paleogeographers and paleobotanists seems promising. The best success in these directions was the research conducted by the Khorezm Expedition (Tolstov 1962; *Nizov'ya Amu-Dar'i* 1960; Itina 1977; Vinogradov 1981; Vinogradov, Mamedov 1975), which convincingly explained the interaction of man and nature from the Copper Age to the Middle Ages. The joint soil and archaeological research of the Institute of Soil Science and Photosynthesis of the Russian Academy of Science, the expedition of Chelyabinsk University (I. V. Ivanov 1983; Khabdulina, Zdanovich 1984), and the investigations of the Samara Institute of the History and Archaeology of the Volga Region (Ivanov, Vasil'ev 1995) are also valuable.

In the present work, the reconstruction of the Steppe paleoecology is based only on the information collected from the archaeological contexts themselves: the topographic location of the sites, the faunal bone materials found in archaeological strata, and correlations between radiometric samples and soil strata. Although at the present time we lack a broad overview summarizing all of these data on Steppe ecology, recently published works, summarizing a large amount of material, including archaeological, are quite useful. These include K. V. Kremenetsky's work (1991) on the ancient history of the Russian Plain, which analyzes the data on the Black Sea North Littoral from the Prut in the west to the Don in the east; E. A. Spiridonova's work (1991) examining the situation in the Don Basin; I. V. Ivanov's and I. V. Vasil'ev's work (1995) analyzing the data of the quite specific region of Ryn-Sands in the Lower Volga Region; Yu. A. Lavrushin's and E. A. Spiridonova's work (1995a, b) on the Ural region; N. A. Khotinsky's works (1977; 1980; 1982) devoted to the Holocene of northern Eurasia and valuable for the reconstruction of the Siberian Steppe paleoecology; and A. V. Vinogradov's and E. D. Mamedov's work (1975) examining the stages of the development of the Kyzyl Kum.

In recent years attempts have been made to correlate paleoecological data with archaeological evidence. Such studies include the research of

N. S. Kotova (1994), Yu. Yu. Rassamakin (1994; 1999), N. L. Morgunova (1995), E. E. Kuzmina (1996–97), and others.

On the whole, this is the current situation. In keeping with N. S. Kotova's data, based on a synthesis of the results of analysis by E. A. Spiridonova and K. V. Kremenetsky, in the western part of the Steppe, from the late sixth to the second quarter, or the mid-fifth millennium B.C., there was a period of aridity, which correlated with the Lower Don Culture. In the third to fourth quarter of the fifth millennium B.C., a moister climatic regime occurred (corresponding to the second period of the Middle Don Culture). The next stage of aridity covers the late fifth to the first quarter of the fourth millennium B.C. and correlates with the Lower Don, Donets, and Late Surski cultures of the Mariupol community. From the second quarter to the end of the fourth millennium B.C., there again was a period of greater moisture. This was the formative epoch of the Tripolye Culture (periods A 4, B 1, 2) and of the sites of the Skelya types and the Sredny Stog and Repino cultures. The decline of the late Tripolye Culture and the beginnings of the Usatovo type sites were demarcated by ecological crisis, the end of the Atlantic period and the transition to the drier Subboreal climate, coinciding with the Hadjibek regression of the Black Sea (Khotinsky 1980). For the eastern range of the Southern Russian Steppe, a fine-grained chronological sequence was worked out by Yu. A. Lavrushin and E. A. Spiridonova (1995a, b), based on palynological profiles cross-dated by radiocarbon dating, found at the Southern Uralian sites and on the flood plain's fluvial deposits.

Around the year 6000 B.C., the Atlantic period began, characterized as the epoch of the climatic maximum and the formation of the present-day landscape zones, which corresponds to the establishment of the Neolithic. Between 4000 B.C. and 3000 B.C., stages of more intensive aridity were recorded, which were also noted for the Caspian Sea North Littoral.

The onset of the Subboreal period is assigned by E. A. Spiridonova to 2500 B.C. The ecological crisis, which covered five centuries, was marked by global cooling and the disappearance of the deciduous forests, which were replaced by coniferous forests. An abrupt change of the ancient vegetation also occurred: the boundary for the grassland Steppe shifted southward to the semi-arid zone of the Caspian Sea North Littoral. Here the accumulation of chernozem and an increase of plant biomass took place. The Repino and Pit-Grave cultures originated in this epoch. Around the year 2000 B.C. there was climatic warming, and, at the same time, increasing aridity, resulting in the expanding desertification not only in the Caspian Sea Littoral but also in the

Don Region. Archaeologically it is the time of the Poltavka Culture. In the period 1800–1600 B.C. there was a cooling trend, an increase in forestation, including pine, birch, lime (linden), and oak, and, also, a growth of the grasslands of the Steppe as well as a rise in their productivity. The Timber-Grave Culture flourished during this period.

In the fifteenth to fourteenth centuries B.C. the climate became warmer, and the Steppe spread, conforming to modern boundaries. In the river valleys, forest vegetation persisted. In the thirteenth century B.C., the onset of a cooling trend and the disappearance of the deciduous species began. The cooling trend reached its peak by the seventh century B.C., when coniferous trees increased in the forest-steppe zone.

The global climatic changes displayed certain peculiarities in the Caspian Sea North Littoral. The results of soil analyses, plus paleozoological, palynological, and paleogeographical studies of the Caspian Sea, show fluctuations (Ivanov, Vasil'ev 1995) indicating that these were particularly strong variations in climatic conditions that had an impact on the ecosystem's productivity.

As a result of these climatic fluctuations, the desert and chernozem-steppe zones shifted in size and boundaries, in some cases by more than 200–500 km from present boundaries between both zones. In the epochs of cooling and increased moisture, which as a rule corresponded to the fluctuations of the Caspian Sea, the multiherbaceous Steppe spread, chernozem soils increased, and conditions became favorable for humankind. During dry and warming periods, on the contrary, deserts appeared, the productivity of the ecological niche fell, brown and semi-desert soil types appeared, and humans abandoned the region. Therefore, as noted by researchers, although the Caspian Sea Littoral developed over time at the same rate and in a similar direction as the Russian Plain on the whole, some archaeological periods are unrepresented.

In the Neolithic and Eneolithic periods, under the humid climatic conditions in the Caspian Sea Littoral, Steppe grasslands existed, allowing humans to populate this region. The advent of the warming period, with its dry, pronouncedly continental climate, leading to the development of the semidesert zone, also coincided with the epoch of the Pit-Grave Culture. Such unfavorable climatic conditions led to the migration of the Pit-Grave Culture population from this region; sites of this period are almost nonexistent.

In the early second millennium B.C. during the Poltavka period, favorable climatic conditions such as a moister regime also resulted in a considerable shift southward of the natural grassland zones. The maximum number of the archaeological sites in the region occurred in this epoch, reflecting the high population density of the Poltavka period.

The epoch that followed, of the Timber-Grave Culture in the Caspian Sea Littoral, is characterized by the advent of warming and another deterioration of the natural conditions, which explains why the Timber-Grave sites are so rare here.

Beginning with the Copper Age and up to the end of the Bronze Age, the range of the Southern Russian cultures included the Caspian Steppe. All the population migrations that returned during the climatically optimal epochs in this region came from the west and the north. Eastward, beyond the Ural River, there was another cultural zone, essentially different from the European one. This regularity of population migrations into optimal climatic zones was noted long ago by A. A. Formozov (1959; 1977) when he studied the Neolithic.

These facts are evidence that the climatic conditions of the Southern Russian Steppe from the Prut to the Urals changed from west to east and at one time period, despite certain disagreements between specialists as to the absolute chronology of the paleoecological events. These discrepancies can be accounted for by the insufficiency of our sources and the variability of the ecosystem itself.

The climatic fluctuations had considerable impact on the living conditions of human communities. The total atmospheric precipitation varied from –50 mm to +350 mm per year, and these changes happened many times during the history of the Steppe. There were also topographical changes from the north to the south of the Steppe, and the biomass of the ecological niche correspondingly (Dzerseevsky 1975; Ivanov, Vasil'ev 1995, 193, 198).

These factors compelled the human population either to migrate to regions with more favorable natural conditions or to change its economic and cultural adaptations through innovation.

Such correlations between climatic conditions and human demography demonstrate the role of ecological factors in cultural evolution, enabling us to study the dynamic interactions between humans and the environment, as well as to discover the reasons for the intensification of cultural contacts, exchange, and the origins of migration patterns along the Silk Road routes.

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