planifrons Falc. and Equus stenonis Cocchi have been identified. The breccia is underlain by a layer of doleritic lava and is covered by lacustrine sands and clays. The lake sediments are overlain by a layer of dolorite (Zaridze and Tatrishvili, 1948). Thus, in that area, the mammals lived and died during a period when the volcanos in the Lesser Caucasus were dormant.

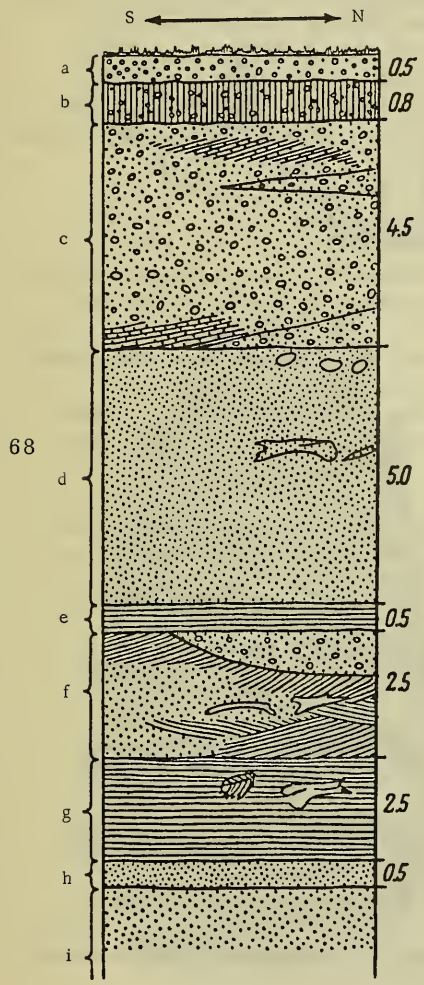

FIGURE 35. Stratigraphic section of bone-bearing sands near Georgievsk

a-c — gravels with obsidian fragments on the high terrace; d-i — light-colored and ferruginous sands with rounded fragments of volcanic ash, bones of elephants and hoofed mammals. Numbers on the right indicate thickness in meters

The next transgression in the Caspian Basin, a somewhat smaller one, is known as the Apsheron sea.

The Kura bay of the Apsheron sea reached the longitude of Kirovabad. The Terek bay was temporarily connected with the Euxinic basin by a strait in the Manych area. The sea reached the latitude of Sarepta and [Lake] Inder in the north.

The climate and landforms of the Caucasus in Apsheron time probably remained the same as in the Akchagyl, and the volcanic activity was of about the same intensity. Torrential mudflows, caused by heavy rains, carried volumes of gravel and boulders from the mountains (Kudryavtsev, 1933); these boulders can now be seen on the Kakhetia Plain.

The land vegetation known from the Apsheron deposits in the Shiraki Steppe consisted of spruce (Picea orientalis) and a number of Recent forms: beech, oak, aspen, apple, willow, filbert, Turkish filbert, walnut (Juglans regia), zelkova, honeysuckle; and Hyrcanian forms: oak (Quercus castaneifolia), alder (Alnus subcordata), maple (Acer ibericum) (Palibin, 1936). Cooling of the climate in Apsheron time resulted in the disappearance of the subtropical evergreens.

The wooded landscape of the shores of the Kura bay was probably similar to those parts of the present-day landscapes of Colchis and Asterabad which are still in a completely natural state.

During the regressions of the Akchagyl and Apsheron seas, arid conditions undoubtedly prevailed in the eastern part of the Caucasian landmass. The development of coastal steppes and semideserts created the environment for dispersal of steppe and desert mammals.

Fossil mammals are more abundant in the Apsheron than in the Akchagyl sediments. The material consists mostly

of single limb bones and teeth of proboscideans and perissodactyls. These burials occur primarily in littoral marine deposits formed in quiet bays at various basin levels. Some occurrences are known from continental deposits: from the zone of accumulation at the piedmont "barrier" at a mountain base, and from the travertines in the Pyatigor'e area.

In eastern Ciscaucasia, "traces" of a faunal complex, similar to those of the Psekups and Taman, occur in the travertines and loams of Mount Mashuk, and in the coastal loams of the Apsheron basin. Bones of elephant and hoofed mammals from the travertines are brittle and some contain cavities formed by dissolution, and filled with calcite crystals. From the oldest, Upper Pliocene "travertine complex" in Mount Mashuk, the following forms have been described: Elephas meridionalis Nesti,
69 E. cf. antiquus Falc., E. aff. trogontherii Wüst, Bovinae, Cervinae (Egorov, 1932; Ivanova 1948; Gromov, 1948).

We collected teeth of Mastodon arvernensis Croiz. et Job., southern elephant (Elephas meridionalis Nesti), horse (Equus cf. stenonis) and bones of deer (Eucladocerus sp.) (Figure 36) from alluvial gray sands below a layer of redeposited basalt fragments and volcanic ash (Figure 35), near the Cossack village of Vinogradnaya and near Georgievsk.

Bones of Elephas meridionalis and Equus sp. have been found in the Apsheron loams on the slope of Mount Tash-Kala near Grozny (Pavlova, 1931). Two teeth of Equus stenonis Cocchi and an antler of a large antelope (Bubalis sp.) found near Verkhni Achaluki on the Sunzha ridge are probably also of Apsheron age (Burchak-Abramovich, 1952a).

The following forms from the locality near the village of Vinodel'noe, northeast of Stavropol, are identified by Borisyak and Belyaeva (1948) in the PIN collections:

Proboscidea

Elephas meridionalis Nesti

Perissodactyla

Equus (stenonis?)sp.

Artiodactyla

Paracamelus gigas Schloss.

A camel mandible from this locality has been described by Khaveson (1954b, Figure 37).

Teeth of southern elephant from the piedmont gravels near Makhachkala have been recorded occasionally.

Apsheron Peninsula

Fossil marine and land mammals are very abundant in the limestones of the Apsheron stage on the Apsheron Peninsula near Binagady, Shikhovo and Baku.

(70)

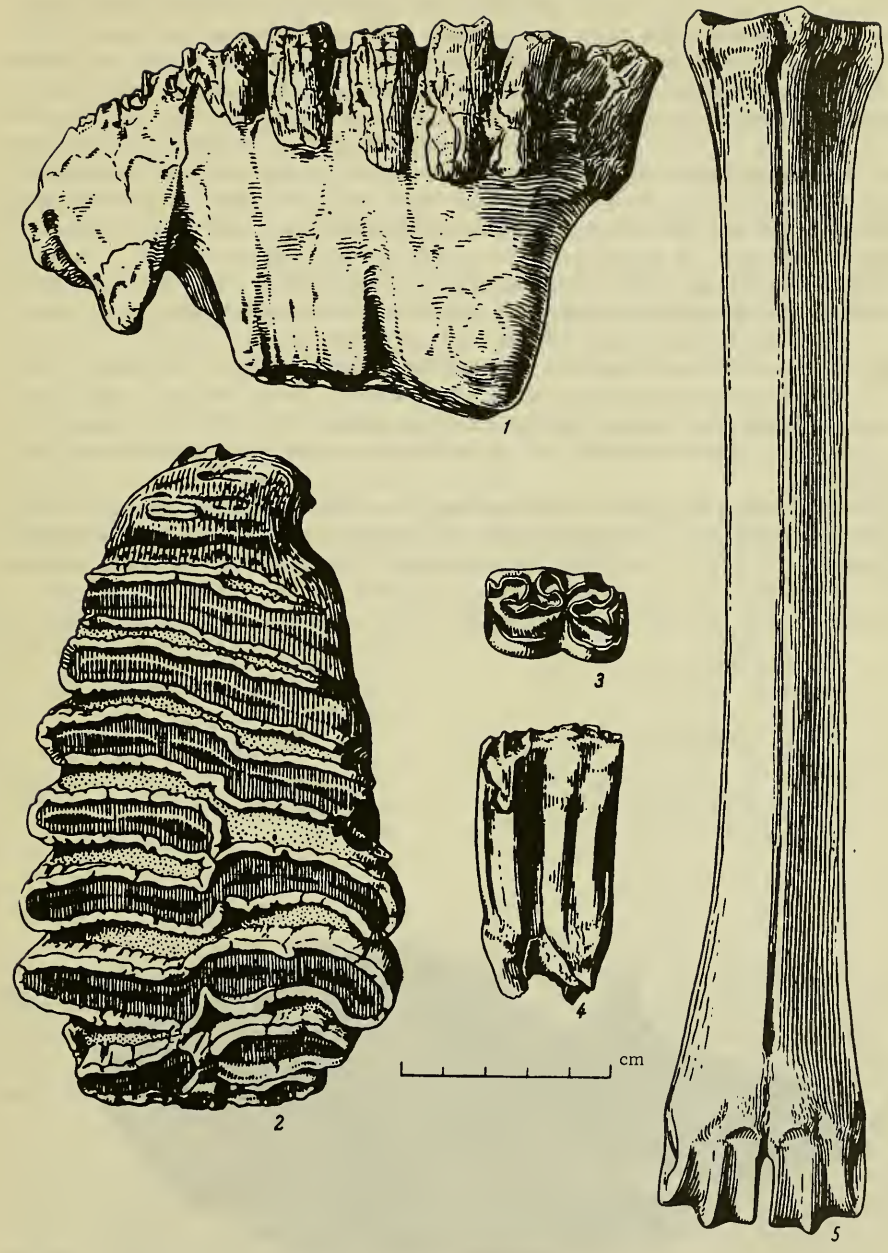

FIGURE 36. Fossils from the river sands in the Georgievsk quarry

1, 2 — M^5 of Elephas meridionalis and worn surface of tooth; 3, 4 — worn surface and inner surface of Pm_3 of Equus stenonis; 5 — metacarpus of Eucladocerus sp.

According to Bogachev (1923, 1938a, 1940d), the fauna includes porpoise (Delphinus delphis L.), an unusual predacious marine pinniped similar to otter and seal (Necromites nestoris Bog.) and perissodactyls (Hipparion crassum Gerv., Hipparion sp.). The humerus of a seal, indistinguishable from that of Phoca caspica Gmel., has been found under a 22-m-thick bed of Apsheron limestone near Baladzhar. The presence of Black Sea porpoise (Delphinus delphis L.) in the Caspian region can be accounted for (Bogachev, 1939a) by migration from the Mediterranean in Akchagyl time, i.e., at the time of migration of the mollusks, Mactra, Cardium and Potamides. According to Bogachev, the dolphin became extinct in the Caspian at the end of the Apsheron because of advancing glaciation.

The same can be said of the incompletely studied Necromites which, according to Bogachev (1940d), is similar to Semantor macrurus Orl. from the Pliocene deposits of eastern Siberia.

Farther west, fossils occur in the clayey ridges of Kabristan and in the two or three parallel ridges of hills which extend from the Iora and
71 Kartalinia plateaus to the Gerdyman-Chai canyon in the east. The hills are made of clays and loams with gravelly intercalations totalling 400 m in thickness.

The material collected by geologists in the Kondzhashen, Palan-Tikyan, Karadzha, Boz-Dag, Chuzgun-Tapa and other ridges has been identified by Bogachev (1938c), Burchak-Abramovich (1951a, 1952c), and the author.

Rodentia

Trogontherium cuvieri Fisch.
Muridae gen.

Proboscidea

Anancus arvernensis Croiz. et Job.
Elephas meridionalis Nesti

Perissodactyla

Equus sp.
Rhinoceros cf. etruscus Falc.
Rhinoceros sp.

Artiodactyla

Cervus sp.
Eucladocerus sp.
Bison sp.

FIGURE 37. Jaw of Paracamelus gigas from Vinodel'noe

It is possible that the upper jaw of Stegodon sp. in the collections of the Natural History Museum in Baku came from some Upper Pliocene deposits in eastern Transcaucasia (Bogachev, 1935).

The most abundant Upper Pliocene species from the Apsheron beds of Transcaucasia are, as a whole, very similar to the post-Kuyal'nitsk fauna of eastern Ciscaucasia. The mastodons occurring in the Apsheron beds were either the last survivors of the eastern Mediterranean group, or they were redeposited from older beds.

Upper Pliocene index mammals have been identified from near Leninakan and Erzurum in the Armenian-Anatolian highlands of southern Transcaucasia. The fossils probably occur in the gravelly-pebbly sands deposited by streams in small, inland, freshwater lakes.

As early as 1899, Abich mentioned an accumulation of fossil bones in Upper Tertiary calcareous marls and conglomerates underlying the layer of tuff and lava on the slopes of a fortified hill near Leninakan. Academician I. F. Brandt has identified "Mastodontidae, Cervidae and Bovidae" in that material.

74 Bogachev (1923-1924) mentioned the finds of Elephas armeniacus Falc. in gray volcanic sands near Leninakan. The species is probably identical with E. meridionalis Nesti.

In later collections from that area Burchak-Abramovich identified bones of Elephas sp., Rhinoceros mercki Jaeger, and Equus stenonis Cocchi (Avakyan, 1948).

The following list (which requires revision) is given by Bogachev (1938c) for species occurring in the Upper Pliocene diatomite near the village of Nurnus on the Zanga River:

Carnivora

Mustela filholi Gaudry
Putorius sp.

Lagomorpha

Lepus sp.

Rodentia

Gerbillus sp.

Perissodactyla

Hipparion sp.
Rhinoceros etruscus Falc.

Artiodactyla

Tragocerus sp.

The diatomite, 7 m thick, occurs between andesitic lavas below and basalt above (Gambaryan, 1934), indicating that a freshwater basin existed in the middle Zanga region in a period between two strong volcanic eruptions. Intercalations of pumice and ash in the diatomite bed show that the volcanic activity also continued during the deposition of the bed.

Occurrence of gerbil bones indicates that xerophilous vegetation thrived along the southern margins of the Armenian Highland in Upper Pliocene time. The stratigraphy of the fossil localities and the species composition of the Upper Pleistocene Transcaucasian fauna indicate that in Apsheron time the climate was temperate, and the volcanos were very active. These data also reflect to a certain degree semi-arid to arid conditions in the southern and eastern parts of the country.

Pleistocene elements are traceable in the Upper Pliocene faunal complex of the Caucasus, particularly in the Taman Peninsula.

(72)

TABLE 5. Stratigraphic distribution of the main localities of Tertiary mammals in the Caucasus

Epoch	Division	Stage	Localities: Black Sea Area and Ciscaucasia
Pliocene	Upper	Chauda beds	Taman Peninsula: Sinyaya gulley, Sennaya, Kuchugury
		Gurie beds	Stavropol area: Voskresenskaya, Trans-Kuban Plain: Psekups, Bakinskaya
		Kuyal'nitsk	Taman Peninsula: Kapustina gulley
	Middle	Cimmerian	Zmeika ridge; Darg-Kokh
	Lower	Pontian	Stavropol Plateau: Kosyakin quarry
Miocene	Upper	Meotian	North Azov coast: Novocherkassk, Tuzlovka
		Sarmatian	Stavropol area: Burlatskoe, Blagodarnoe, Petrovskoe
	Middle	Konka Karagan Chokrak Kuchugury Helvetian	Stavropol area: Belomechetskaya
	Lower		
Oligocene			

(73)

Stage	Localities: Caspian Area and Transcaucasia	Predominant Groups of Species
Apsheron	Terek Range: Malgobek, Grozny, Achaluki Apsheron Peninsula: Binagady, Khurdalan, Shikhovo Armenian Highland: Leninakan, Nurnus	Taman wolf, southern elephant, Trogontherium, Equus stenonis, Cervus pliotarandoides, Taman bison
Akchagyl	Iora Plateau: El'dar, Dzheiran-Cheli Kirovabad Plateau: Karasakhkal, Naftalan Iora Plateau: Palan-Tikyan	Mastadon arvernensis Aceratherium Hipparion Cervus pliotarandoides
Productive beds	Apsheron Peninsula: Lok-Batan	Fox, deer, gazelle
Pontian		Dinocyon, Mastodon arvernensis, hamster, Dicerorhinus, tapir, Hipparion, roe deer
Meotian Sarmatian	Kartalinia Plateau: Dzhaparidze Gori valley: Arkneti Iora plateau: El'dar, Udabno Kartalinia Plateau: Kyasaman, Kotsakhuris-Kedy	Hyena, long-snouted mastodon, Aceratherium, Hipparion, giraffe, gazelle
Konka Karagan Chokrak Helvetian		Amphicyon, swamp mastodon, Paranchitherium, Anchitherium, giant swine, antelope
	Dzhavakhetia: Akhaltsykh	Benaratherium Chalicotherium Anthracotherium Tragulids

The Neogene faunal complexes of the Caucasus are not endemic. The Oligocene "fauna" of the Lesser Caucasus is related to the central Asian and European "faunas" of the same period.

The Middle Miocene "fauna" of Ciscaucasia, known from Belomechetskaya, is also related to the Miocene "faunas" of Eurasia and North America. This "fauna" migrated over temporary land bridges from the north and south, although the trend from the south was more pronounced.

In the Upper Miocene, Sarmatian, the Hipparion complex migrated to the Caucasus from the south over land which joined the island of Caucasus with Asia Minor.

The local fauna of the mountains has probably evolved since the Miocene. Some of the surviving, endemic elements of the highland fauna are undoubtedly descendants of Upper Miocene forms.

75 Evolution of the Pliocene faunal complexes in the piedmont and the plateaus can be traced mainly to migrations from the north and south. The hot, dry climates of the Pliocene produced a more pronounced southern influence on the evolving fauna.

It is only at the very end of the Pliocene that the northern faunal elements became important. So-called Pleistocene genera and species appear during the general cooling at the end of the Pliocene. Evolution of endemic species in the Pliocene occurred mainly in the highland regions and left relicts on the peneplain.

The paleontology of the Caucasian land mammals does not support the hypothesis of a "Pontian landmass" in the Black Sea Basin connecting western Caucasia, the Crimea and Asia Minor (Andrusov, 1918; Vul'f, 1944; Puzanov, 1949). This hypothesis has also been discarded by geologists (Muratov, 1951). However, it is more than likely that dry land existed in the Upper Pliocene where the Sea of Azov now lies (Vereshchagin, 1957).

A stratigraphic summary of Caucasian localities of Tertiary land mammals is given in Table 5.

Many forms of the Upper Pliocene Taman complex survived in the Caucasus and continued to evolve through the Lower and Middle Pleistocene.

76 *Chapter II*

DEVELOPMENT OF CAUCASIAN LANDSCAPES AND MAMMALIAN FAUNA IN THE QUATERNARY

THE PLIOCENE — PLEISTOCENE BOUNDARY IN THE CAUCASUS

The specific features of evolving landforms in this area between two ancient continents make the identification of the Pliocene-Pleistocene boundary difficult.

The variety of zoogeographic zones and the complexity of their boundaries developed in the Upper Pliocene as well as in the Recent.

Therefore, any study of the geomorphology based upon single occurrences of plants and animals in continental deposits often reflects only local conditions.

This problem, as it concerns the European continent, is still under discussion by geologists and biologists (Zhirmunskii, 1936; Nikolaev, 1947, 1950). We agree with Nikolaev that the Pliocene-Pleistocene boundary must be identified on the basis of all available data of the various disciplines, rather than on isolated criteria.

A variety of geomorphological changes caused by the interplay of tectonics and climate have been proposed as the markers of the Pliocene-Pleistocene boundary. Such markers are sea level fluctuations, orogenic and erosional cycles, glaciations, evolutionary changes of plants and animals, and morphogenetic stages of fossil lineages.

The lower boundary of the Quaternary has been variously placed — in the Upper Sarmatian by geologist Kovalevskii (1936) and botanist Grossgeim (1936); at the end of the Akchagyl by geologists Reingard (1931, 1936a), Gerasimov and Markov (1939) and paleontologist and geologist Gromov (1948); and in the Upper Apsheron by geologists Pavlov (1936), Mirchink (1936b) and Vardanyants (1948).

The Russian zoogeographers Menzbir (1934) and Serebrovskii (1935) did not resolve the question when they applied Western European stratigraphic concepts to the Caucasus.

The hypothesis of Kovalevskii, Grossgeim and Shvetsov (1928) that the
77 Pliocene continental glaciations in the Caucasus correlate with the Günz and Mindel glaciations is no longer accepted.

Gromov (1948) inferred from the geomorphological and paleontological data that, some time at the Tertiary-Pleistocene boundary, the climate became more severe which, however, did not imply an extensive glaciation. He considered the Khapry and the Psekups faunal complexes (see Chapter I) characteristic of the transition from the Pliocene to the Pleistocene in

Ciscaucasia and the southern part of the Russian Plain, and placed the Taman complex at the base of the Quaternary. *

At that time the following forms were considered indicative of early preglacial time on the Caucasian Isthmus: Elephas trogontherii (E. wüsti M. Pawl.), Bison schoetensacki Freud., Elasmotherium caucasicum Boris., Cricetus cricetus L., Spalax microphthalmus Güld. The faunal break was expressed in the disappearance of mastodon, elephant (Elephas planifrons and E. meridionalis), Hipparion and Etruscan rhinoceros, coupled with the appearance of bison. Thus Gromov's biostratigraphic criteria of the upper margin of the Tertiary are similar to those of West European authors: the Khapry and Psekups complexes coinciding with the Günz and Günz-Mindel glaciations, and the Taman complex with the Mindel glaciation of the West European glaciological scheme.

The first erosional cycle in the Quaternary occurred in the Günz. The cycle is represented by gravels of the Kuban River terrace which are 175 m thick.

Similar paleontological considerations have been put forward by Pidoplichko (1940c, 1952, 1954) for the northern Black Sea coast and the Ukraine.

New paleontological data have confirmed that pronounced qualitative changes in the flora and fauna of the Caucasian Isthmus occurred only at the end of Apsheron time. These changes are indications of a mildly warm or temperate climate.

Silicified wood of broadleaf species — oak (Quercus sp.), beech (Fagus sp.) and elm (Ulmus sp.**) — has been recorded from Upper Pliocene freshwater beds near Kuchugur on the Taman Peninsula, and in the lower part of the alluvial sands in the Girei quarry on the Kuban. It is quite possible that subtropical species did not exist in the Caucasian flora of this period. An abundance of terrestrial mollusks (Chondrula, Helix) and freshwater mollusks (Corbicula, Anodonta, Bithynia, Micromelania and other species) in the post-Kuyal'nitsk continental beds of the Taman Peninsula and in the Upper Apsheron beds of eastern Transcaucasia, is evidence of a temperate climate.

It was in Upper Apsheron time that mastodon and Hipparion became extinct in the foothills of the northern Caucasus. The forms which then appeared were horse (Equus cf. stenonis, E. aff. süssenbornensis), Elasmotherium caucasicum, camel (Paracamelus) and bison (Bison sp.).

78 The morphogenesis of the Caucasian elephant (Elephas meridionalis — E. trogontherii) was in a transition stage during the Upper Apsheron (Vereshchagin, 1957a).

The picture is similar in the continental deposits of the Transcaucasus, particularly so in the Armenian Highland. However, the chronological correlation with the Ciscaucasian localities is uncertain, despite the similarities in the composition of the faunal complexes and in the morphogenetic stages.

* When Gromov wrote this, the Taman complex was poorly known; in point of fact, it is very similar to the Psekups and Khapry complexes (Vereshchagin, 1957a).

** Identified by A.I. Zubkov.

Thus at the end of Apsheron time, new cycles of erosion and mountain formation commenced on the Caucasian Isthmus; the flora developed a temperate or, in some places, a xerophilous aspect, and the vast areas from which the seas receded came to be inhabited by ungulates of a type adapted to the steppe, or even to the desert.

Taking into account that this continental phase undoubtedly covered a very long period, we agree with Pavlov (1936) in placing the beginning of the Anthropogene in the Caucasus at the end of the Apsheron sea regression and at the beginning of the Baku sea transgression.

THE PROBLEM OF THE CAUCASIAN CLIMATES AND LANDSCAPES IN THE PLEISTOCENE AND THEIR BEARING ON THE EVOLUTION OF FAUNAL COMPLEXES

The chief considerations in studying the development of the climates and landforms of the Caucasus in post-Apsheron time are the following:

1. Tectonic cycles and the dynamics of the land relief created by river erosion.
2. Fluctuations of the sea level and the land connections between the Ciscaucasus and the Russian platform.
3. The extent and number of glaciations as related to the tectonics and climatic fluctuations.
4. Changes in flora and formation of vegetation zones.

These factors have been studied in the Caucasus on an empirical basis, disregarding the paleontological material. A summary of these studies would be germane to the overall problem of the history of the fauna.

Dynamics of land relief. In the Pleistocene the dynamics of the relief of the Caucasus was highly complicated. The peneplanation of the ancient mountains of the Greater and Lesser Caucasus at the end of the orogenic period of the Top Pliocene (Apsheron age) is a fact accepted by geomorphologists.

Remains of an ancient peneplain are in fact observable in the Main Range, e.g., in Abkhazia, Svanetia and Kabarda, and particularly in Dagestan. At the end of the Pliocene, the poorly drained, boggy alpine plateaus of the present Dagestan highlands were probably no higher than 500-800 m above sea level. The peneplain is considered to be of either Apsheron or Baku age; Mirchink (1936a) regards it as Upper Apsheron-Lower Baku. Some ridges in the region of Vodorazdel'nyi and the Bokovye ridges presumably did not rise over 1,000-1,500 m above the level of the Apsheron sea. Plant and animal fossils from these plateaus would have been
79 of great interest in the study of the faunal complexes. Unfortunately, their preservation was probably precluded by the action of rapid drift and erosion.

According to Nikolaev (1941, 1949) the relief of the inner plateaus of the Greater Caucasus is much older than Apsheron time. The relief of the Armenian Highland (Paffengol'ts, 1948, 1950) can be traced as far as the time in the Lower Quaternary when Lake Sevan was formed by the lava flows from the Bogu-Dag volcano which dammed the deep erosional valley of the paleo-Zanga River.

Nikolaev (1941, 1949) places the maximum uplift of the Greater Caucasus, following a series of oscillating, tectonic movements, at 3-4 km,

which was reached in "post-Upper Pliocene" time. On the basis of their studies in Dagestan and Ossetia, Reingard (1939) and Vardanyants (1933b, 1948) hypothesized that the central part of the Main Range is a horst, which was uplifted by 1,000-1,500 m. The figure of 3-4 km is probably the sum of the uplift of the Central Range and the subsidence in the Black Sea and Caspian Sea depressions.

The most recent tectonic movements have been detected in the central Caucasus, in the Stavropol area and on the Taman Peninsula. The laccoliths in the Pyatigor'e area, which stand out in the surrounding relief, "underwent a relatively greater uplift than the surrounding areas." Ronov (1949), working by a "volume method," stated that the uplift of the Greater Caucasus in the Pleistocene was nearly 2,000 m.

Thus, by a general consensus, the relief of the Caucasian mountains resulted from arching, or, in some places, from horst uplift, and from a concomitant subsidence in the piedmont plains and in the Black Sea and Caspian Sea depressions.

Because of these tectonic movements, the younger terraces in the foothills were formed close by older, denudational terraces, which, in the plains, disappeared completely under the younger ones. This overlapping of terraces is very important in a stratigraphic correlation of terrace deposits and in fossil dating.

The uplift of the Caucasian mountains inevitably resulted in glaciations (which are discussed in more detail below) and in the formation of a rocky relief with numerous cuestas and talus in the faulted areas. The new topography allowed an expansion of plant and animal species adapted to a rocky terrain. The higher relief also promoted a greater ecological and morphological differentiation which was reflected in the formation of new habitats and in the division of existing ones.

The slopes of the ridges which rose during the Pleistocene were actively eroded by rivers. Mountain streams deepened their valleys, stage after stage, forming terraces which correspond to the mountain-building cycles. Rivers cut through the young rising ridges forming narrow canyons in the process.

Such post-Pliocene canyons occur on the northern slope of the Main Range (along the Baksan, Chegem, Cherek and Urukh rivers); in eastern Transcaucasia (along the Geok-Chai, Tur'yan-Chai, Alazan, Kura and Mtskheti rivers); on the southeastern spurs of the Karabakh Mountains (along the Araks River), and in Talysh (along the Vazaru-Chai river).

80 The differential uplift of the mountain ridges combined with river erosion produced sheltered valleys, screened by ridges, which captured atmospheric precipitation and resulted in the development of temperate, arid areas in the highlands. These were a refuge for plants and animals adapted to drought. During the Pleistocene such areas existed in Dagestan, in the longitudinal mountain valleys of Ossetia and Kabarda, in the Gori depression on the Kura River, in the upper part of the Pambak River valley on the Armenian Highland, and in the Zuvanda depression in Talysh. These areas are still inhabited by xerophilous animals: suslik, hamster and steppe vole.

Karstic niches and caves which were created in limestone terrain by river erosion became habitations for some predator species and, later, for man.

A thick mantle of gravels and loams formed in the piedmont during the Pleistocene from the transport of clastic material by rivers from the

mountains. Such deposits cover the Trans-Kuban and Terek-Sunzha valleys, the Kusary and Kirovabad plains in Transcaucasia, and the terraces on the Black and Caspian seacoasts.

These piedmont plains were inhabited by mammals associated with the forest-steppe and with moderately humid climatic conditions. The piedmont plains were also the paths of migration from north to south, and vice versa, of those species which lived on the lowland plains.

Vulcanism has had a pronounced effect on the relief and hence on the areas of species distribution in the highlands and on the piedmont plains (Apsheron and Taman peninsulas). In the Armenian Highland the lavas covered great areas of the plateau, sometimes nearly 50% of a whole area (Maruashvili, 1946). Volcanism affected the distribution of animal species both directly and indirectly. For example, the absence of forests in western Armenia is, according to some geobotanists, the result of the volcanic activity and lava flows of the Pleistocene (P. Yaroshenko, 1941).

The orogenic cycles were probably closely related to fluctuations in sea level during the Quaternary.

Fluctuations of sea level. The transgression of the Baku sea, which followed the Apsheron regression, was characterized by an abundance of Didacna. The next stage, the Khazar sea, was characterized by the archaic Didacna surachanica Andr. The equivalent in the Black Sea Basin was the Neo-Euxine sea. The Khazar sea was followed by the brackish Khvalynsk sea which extended far to the north leaving brackish-water mollusk fauna near Ural'sk and Kazan. The Khvalynsk sediments
81 correlate with the beds of the Ancient Black Sea. The last major transgression in the Caspian depression (Khvalynsk sea) is usually thought to correspond to the last stage of glaciation of the Caucasian Range. The Khvalynsk sea receded into the postglacial Caspian, in which later transgressions were only minor and did not extend much beyond the present coastline (Kovalevskii, 1933; Figure 38).

The major Pleistocene transgressions considerably reduced the coastal terraces on the east and west coasts of the Isthmus.

Sea erosion of the piedmont barrier, as in eastern Transcaucasia, or of the coastal plains restricted the areas of distribution and migration of animals on the plains. The alluvial plains were also affected by marine erosion: the Yeisk-Kuban, Kuma-Terek, Rion and Kura-Araks plains, which, at various times, were inhabited by faunas of diverse origins.

The Manych strait formed during the transgression must have restricted the migration of animals from the Russian plains at least to the extent that hibernating animals could not have migrated over ice-covered country.

During the regressions the low-lying areas remained covered by broad salinas and marshes with residual lagoons and lakes. Desalinization of these areas progressed rapidly in western Ciscaucasia where steppes
82 developed. In eastern Ciscaucasia, desalinization proceeded at a slower rate. There semideserts developed, inhabited by jerboas, gerbils, saigas and goitered gazelles. Residual lakes and lagoons became plavni overgrown with nymphaea and bulrushes. Colchis developed a marsh-type vegetation consisting of alder, nymphaea, sedge and sphagnum. The longevity of such marshy tracts depended on the hydrological regime of the feeding rivers and the rate of alluvial fill. The fauna of these marshes included such hydrophilous animals as otter, water rat, European beaver and boar.

(81)

FIGURE 38. The Caucasus and the Caspian in the Upper Pleistocene

1 — old freshwater sediments in the Volga Basin; 2 — Aral-Caspian marine transgression; 3 — region of Quaternary glaciation (from Kovalevskii, 1933)

Extent and number of glaciations. Climatic fluctuations and glaciations in the Caucasus could have been the most important factors in the development of the fauna.

Data on Caucasian glaciations is based on the geomorphology of the area and on the relationships between the glacial and orogenic cycles and the sea level stands. Correlation of these data has been complicated by the attempts of Russian geologists to identify Caucasian glaciations with the European glacial stratigraphic scheme developed for the Alps. There has been almost no original stratigraphic work done to date on the glaciations in the Caucasus that is free of this "Western glaciological hypnosis." Geomorphological studies show those peculiarities which distinguish the development of the Caucasus during the Pleistocene from the development of the Alps.

Academician Pavlov (1925) believed that the end of Apsheron time in the Caucasus coincided with the Pliocene (Günz) glaciation, and that it was marked by the uplift of ranges causing a formation of mountain glaciers and intensive deposition of the gravels which are common in the upper part of the Apsheron suite. According to Pavlov, the Mindel glaciation correlates with the upper Baku and the Riss glaciation with the Upper Khazar, while the

Khvalynsk corresponds to the time when the Würm glaciers waned. Essentially this correlation is still valid.

Reingard (1937, 1947b) recognized four or five major stages of glaciation in the Caucasus. The first (Günz), which glaciated as far as the piedmont, occurred in the transition from Akchagyl to Apsheron time, and is represented only by scattered gravel deposits. The Mindel glaciers extended 80 km north on the piedmont plain of the central Caucasus during the Apsheron-Baku transition period. This glaciation was followed by the long second interglacial, during which thick sequences of diluvial loams accumulated from transport of clastic material from the mountains. The third glaciation, the Riss, was the most extensive and its erosional effects in the valleys were the most pronounced. During the interglacial which followed, the glaciers remained only on the mountain peaks. During the fourth and the last glaciation, the glaciers covered only the mountain valleys, and subsequently receded in four stages, with one advance which occurred in the Middle Ages of our era.

83 According to Reingard, the rise in the level of the Caspian Sea was related to the decrease in evaporation at the time of glaciation. Initially, the sea level rose slowly. Later, during the melting of the glaciers, the rise was more rapid, attaining its maximum in the second half of the glacial phase. At that time, the Black Sea level had not yet reached its maximum (Figure 39).

According to Gerasimov and Markov (1939), the entire glacial history of the Caucasus can be subdivided into two periods. During the first period (Akchagyl-Apsheron), one or two glacial phases occurred in central and eastern Caucasia as the result of the uplift of the mountains. In the second period (the second half of the Quaternary), two glacial phases developed in the Greater Caucasus, "the mountain framework formed by the Lower Quaternary tectonic movements." The authors doubted any synchrony between these and the alpine glaciations, although they were certain of "basic changes in climate which occurred several times, along with a number of glaciation (3-4) in the Caucasus."

A record number of ten glaciations beginning with the Upper Miocene has been given by Kovalevskii (1936).

84 Three or four glacial phases in the Caucasus have been suggested by Vardanyants (1948). However, he tended to accept Gromov's (1935b) subdivision into two glacial epochs corresponding to the Riss and Würm of Europe: the Riss corresponding to the Early Khazar, and the Würm to the Early Khvalynsk, with corresponding stages of retreat following each (Figure 40).

In the Black Sea Basin the periodically established connections with the ocean were controlled by the uplift and subsidence in the Bosphorus-Dardanelles region and modified the processes of glaciation and transgression. A stratigraphic summary of Vardanyants' is given in Table 6. *

A number of marine basins periodically connected the Aral, Caspian, Black and Mediterranean seas, and their waters interchanged with the fresh waters of the Caspian through the Manych strait. Increase in salinity of the basins was due to the penetration of the Mediterranean water eastward in post-Tertiary (Karangat and Ancient Black Sea) time.

* Other geologists, for example Popov (1955), correlate the Khvalynsk time with the Neo-Euxine beds, the Khazar time with the Karangat beds, etc.

It seems strange that the views of geologists on the extensive glaciations in the Caucasus were supported, rather than opposed, by biologists.

(83)

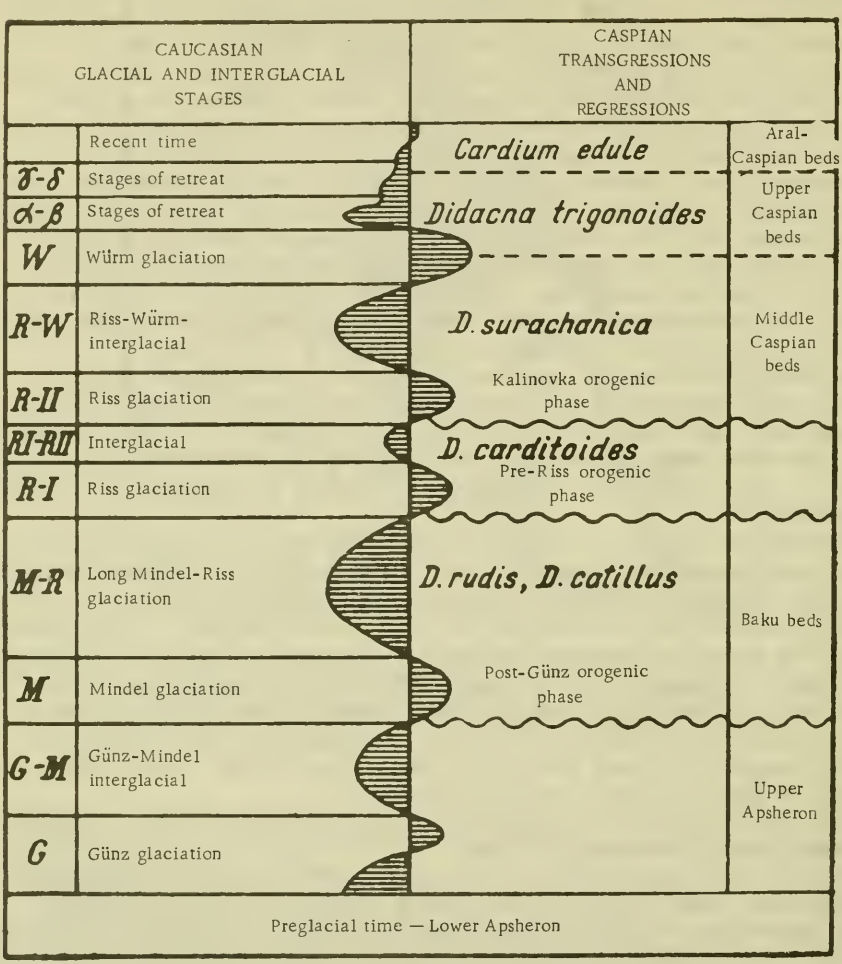

FIGURE 39. Relationships between glaciations, orogenic phases in the Caucasus and fluctuations of the Caspian Sea level (according to Reingard, cited in Bogachev, 1940)

Formation of vegetation zones. According to the botanists Kuznetsov (1909) and Medvedev (1915) and the zoologists Satunin (1910)
86 and Dinnik (1911), there was only one glacial phase during which the Caucasian fauna and flora were saturated with northern forms, and the mountain animals and plants had to seek refuge on the plains.

From an analysis of Recent Caucasian flora, Grossgeim (1948) has inferred a number of hot interglacials, in order to account for the presence of xerophilous southern plants at a number of places in the Caucasus. Geobotanists Maleev (1946) and Kolakovskii (1947b), who studied the origin of the eastern Mediterranean flora (in particular, that of Colchis), also

(84)

FIGURE 40. Glaciation in the Caucasus during the pre-Khazar orogenic phase

1 — inferred outline of the sea; 2 — areas of glaciation (from Vardanyants, 1948)

accepted the notion of several glacial epochs and warm interglacials. They connected the occurrence of mesophilous broadleaf forests to the pluvial glacial periods, and the reduction of mesophilous flora, with concomitant development of semixerophilous and thermophilous vegetation, to the arid interpluvials. These conclusions are based either on studies of discontinuities in plant distribution, or on the geological literature (Vereshchagin, 1949c). An interplay of many factors, other than climatic, is responsible for discontinuities in the distribution of species. Even the penetration of northern plants (e. g., sphagnum and sundew) far into the south — to the Greater Caucasus, the marshlands of Colchis and the Lesser Caucasus highlands — cannot be correctly evaluated unless all the factors which control species distribution are known. The use of phytocenotic transformations to detect climatic changes is open to question even when applied to a period of time as short as the historical epoch (e. g., Sinskaya, 1933; Fedorov, 1952). The Pleistocene climatic changes cannot be evaluated from the fossil plant record alone because the number of known macroscopic plants is small. However, the available paleobotanical and geobotanical evidence indicates that the flora of the Caucasus in the Middle Pleistocene resembled the Recent flora and the plant habitats had the essential aspects of the Recent. The arboreal vegetation at the end of the glacial epoch was also similar in type and in distribution areas to that of Recent time (Grossgeim, 1936, 1948).

The valley glaciers of the past, as, for instance, those on the slopes of western Caucasia, were much larger than those of the Recent. This is

(85) TABLE 6. Stratigraphic summary of post-Terriary history of the Black Sea, the Caucasus and the Caspian Sea (from Vardanyants, 1948, p. 23) and connections via the Bosphorus and the Manych region

Bosphorus	Black Sea	Caucasus		Manych	Caspian Sea
	Recent sediments	Bühl stages		Open (?)	Post-Khvalynsk layer
Closed	Subsidence, regression, decreasing salinity	Uplift, glaciation (Bühl or Neo-Würm)		Closed	Regression
	Ancient Black Sea beds	Würm stages		Open	Khvalynsk layer
Open	Subsidence, influx of seawater	Uplift and glaciation (Würm)		Closed	Regression
	Neo-Euxine beds	Riss-Würm		(?)	Khazar layer
Closed	Subsidence, regression, decreasing salinity	Uplift and glaciation (Riss)		Closed	Regression
	Karangat beds	Mindel-Riss		Open	Upper Baku (transitional beds)
Open	Subsidence, influx of seawater		Uplift	Closed	Regression
	Uzunlarskoe and Ancient Euxine beds			Closed	Middle Baku Lower Baku
	Chauda beds	Uplift and glaciation (Mindel)		Closed	Regression
	Krasnodar horizon?	Günz-Mindel		Closed	Upper Apsheron
Closed	Regression and decreasing salinity (?)	Uplift and glaciation (Günz)		Closed	Regression
	Guri beds			Open	Lower and Middle Apsheron

indicated by the occurrence of glacial troughs and terminal morainic ridges in the valleys of the Laba, Zelenchuk, Kuban, Baksan and other rivers in the area (Figure 41).

The glacial troughs occur in the upper parts of the valleys, far short of the Skalistyi ridge. It is clear that there were no basic differences in the environments of the faunal and floral complexes between the time when the valleys were covered by glaciers, and the Recent. The vegetation of the highlands descended, although it was not completely displaced, to the
87 piedmont plains.* During the period of maximum glacial advance, there was adequate living space for mountain animals on the meridional and lateral mountain ridges near the glaciers. Even at present, mountain forests

* Even Grossgeim (1936, p. 203), allied as he was with Kovalevskii, was compelled to recognize this fact.

(coniferous, broadleaf and mixed) and mountain animals exist close to the glaciers, as on the Cherek, Urukh and Rion rivers (Figure 42).

The gravel beds and large boulders in the piedmont plains were more likely the result of mudflows, caused by floods and volcanic activity, than relicts of hypothetical glaciations.

The evolution of mammalian faunal complexes must be related to the snow factor and to the latitudinal shift of the climatic zone on the Russian Plain caused by the northern European glaciation. However, the depth and duration of the Pleistocene snow cover have not been studied, and can only be inferred from examples of distribution and migration of some mammals in the Recent.

FIGURE 41. Glacial trough and terminal moraine, overgrown with pine, in the Tseya ravine in North Ossetia

Photograph by author, 1947

The occurrence of boreal plant species in the Caucasus can only be accounted for by the proximity of the Riss glacier tongues to the Caucasian Range (Medvedev, 1915; Grossgeim, 1936, 1948). In other words, it is assumed that tundra and taiga existed in the Manych area and in the Salsk
88 steppes. Results of recent palynological and paleontological studies indicate that steppes always existed between the lower Don and the lower Volga rivers.

We will evaluate the paleontological and zoogeographical data in the Caucasian stratigraphy after we review the Pleistocene localities. It should be noted that the hypothesis of extensive continental glaciation in the Caucasus implies that the evolution of all the highly specialized forms

(mountain goat, snow mouse and other forms) took place within a very short time — the postglacial period.

The glacial stratigraphic scheme, particularly the hypothesis of continental glaciations in the Caucasus, should be reviewed with reference to biological data.

88)

FIGURE 42. Glacier and forest in the upper reaches of the Rion

Photograph by author, 1957

Absolute geochronology of the Quaternary. Application of the absolute time scale of the Quaternary to the Caucasus did not produce new results. Most Russian authors accepted the estimates of Soergel (1925) and Milankovich (1939) of 600,000-650,000 years as the duration of the glacial epoch. In estimating the time of origin of the Aral-Caspian sea at 23,000 B.C., of the Khazar sea at 13,500 B.C. and of the Khvalynsk sea at 3,400 B.C., Kovalevskii (1933) condenses the entire history of man and the evolution of the Caucasian fauna into a very short period of time. Later
89 investigators have found that the Quaternary orogenic processes and glaciations in the Caucasus lasted much longer — 500,000-600,000 years according to Vardanyants (1948) or even 1,000,000 years according to Nikolaev (1949) and to Ronov (1949). These estimates, which are of great importance in the calculation of the rates of evolution, speciation and development of the fauna, will undoubtedly be amended in the course of future studies of the physicochemical composition of rocks, bones and sediments. The only Caucasian stratigraphic stage with a satisfactory paleontological record is the Upper Pleistocene — presumably the time when glaciation reached its maximum extent.

MODE OF OCCURRENCE OF FOSSIL MAMMALS AT THE PLEISTOCENE LOCALITIES

Pleistocene localities are more amenable than those of the Tertiary to studies of the conditions of animal death and deposition.

In the Caucasus Quaternary mammal fossils occur in marine terraces along the coasts of the Black, Azov and Caspian seas, in river and lake terraces, in the surface loams and in caves.

Only a few occurrences of mammals in marine and lagoonal sediments are known in post-Apsheron strata. This is probably due to the latest tectonic processes, since it is unlikely that the variability of the animal world in the Pleistocene was any less than in the Tertiary.

The bodies of animals which had died from various causes (see Introduction) accumulated at river mouths and estuaries. Smaller accumulations formed in the alluvial sediments of the middle and lower parts of rivers. All such sites in the lower parts of the valleys of the Kuban, Terek, Rion and Kura rivers are at present in the zone of tectonic subsidence, in which sediments continue to accumulate. Consequently, most of the sites remain concealed by the sedimentary cover and can be discovered only in the processes of drilling and quarrying.

Exceptions to this usual mode of occurrence are found in those sites which were at the head of coastal bays, provided the bays were in the area of the later uplift of the foothills. Such localities are found in the middle parts of the Kuban (Kropotkin, Nevinnomyssk), on the Terek River (near Mozdok and Kotlyarevskaya), on the Rion (at the longitude of Kutaisi and Zestafoni), and on the Kura (in the Mtskheti-Tbilisi area).

It is possible that several fossiliferous layers occur at localities in a "zone of undulation" (i.e., longitudinal depressions and swells) because favorable hydrological conditions prevailed over several epochs.

Most of the Pleistocene mammals are found as intact or fragmented skeletons in continental deposits of various origins (alluvial, lacustrine, diluvial, eolian) in caves, travertines and asphalt pools, on the plains and in the foothills of the Caucasus Isthmus.

Although life was precarious in the mountains and avalanches, falling
90 rocks, slippery, ice-covered surfaces and hunger brought frequent death to the animal communities, the chances were poor for the preservation of their remains. The fine-grained alluvial sediments of mountain rivers did not offer much likelihood of preservation either. Such sediments are usually thin and tend to shift with time (Shantser, 1951). Fossil vertebrates do not occur, as a rule, in the terminal and lateral moraines of mountain valleys, because of the attrition of bones in the process of moraine deposition.

The diluvial sediments at the foot of the mountains, far from the valleys of large rivers, do not contain fossil accumulations, since skeletons were usually destroyed during the slow deposition of the sediment.

Skeletons of animals carried by torrential streams onto the plain areas stood a better chance of preservation in the thick mud and conglomerates formed by the streams. Mudflows continued to cause destruction and death among animals throughout the Quaternary; they have been vividly described by Ivanovskii (1911) for the Araks River valley, and by Muratov and Gvozdetskii (1948) for the Khasaut valley in the northern Caucasus. Mudflows are also known to have occurred in the rivers of eastern

Transcaucasia, for example, in the Demir—Aparan-Chai ravine.

Mudflows are produced by such factors as heavy rains and volcanic eruptions which melted the firn and ice. The flows, which were more frequent and powerful in the Pleistocene, killed masses of animals.

Heavy snow and surface ice were probably common causes of violent death among the Pleistocene animals of the plains, just as they are among the Recent animals. On the plains beyond the river valleys bones were rarely preserved and then only in the gulleys and diluvial loams.

Disposal of food remains by primitive man at campsites and in caves added a new factor to the accumulation of Pleistocene fossils. The prey carried by predatory animals and owls also contributed to the bone accumulations of many species at the same cave sites.

This type of death assemblage occurs most frequently in the mountains and is the main source of information on the history of the mountain fauna.

The sections which follow are devoted to the discussion of the major localities by regions.

PLEISTOCENE BONE-BEARING LOCALITIES

Western Ciscaucasia

Following the deposition of the bone-bearing Psekups gravels and conglomerates on the Taman Peninsula, no rich, diversified mammalian accumulations are known for quite a long time. The Lower and Middle Pleistocene fossil record consists mostly of teeth of *Elephas meridionalis* and *E. trogontherii*.

91 On the Kuban Plain, i.e., on the right bank of the latitudinal section of the Kuban, fossil mammals occur at great depth in the sediments of ancient rivers which ran off the Caucasian mountains.

The remains were deposited on the edges of floodplains of the plavni or liman type fed by mountain streams, probably beyond the zone of deposition of coarse clastics.

The clays and sands of the Kuban Plain (e.g., those in the Krasnodar area) contain bones of large Middle Quaternary mammals of Khazar time, along with wood and freshwater mollusks (*Unio*, *Paludina*) (Pravoslavlev, 1932). The overlying beds are loess loams with occasional intercalations of volcanic ash. In addition to mammals and plants, these beds contain terrestrial mollusks (*Buliminus tridens* Müll.), which are indicative of a steppe environment.

Bones of "*Bos*, *Equus*, *Cervus*, *Elephas*" have been recorded by Pravoslavlev and Ansheles (1930) from the 50-m-thick loams near the Cossack village of Temizhbekskaya.

A number of fossils from other localities were identified by the author in 1952 in the Krasnodar Museum. These include the teeth and skull fragments of an early mammoth, *Elephas trogontherii* — *E. primigenius*, from the village of Dinskaya, and remains of a long-horned bison, *Bison priscus longicornis*, from the village of Krylovskaya on the middle Chelbas. The skeleton was buried in the silty sand of a stagnant-water basin. The bones were only slightly permineralized and resembled alabaster in their appearance. Bones of

Bison priscus longicornis and mammoth were preserved under similar conditions near the village of Skobelevskaya. The bones were found in a silty marsh bed 16.5 m beneath the loess. Elongated grooves, the tracks of boring invertebrates (Trichoptera larvae ?!), occur on the surfaces of the bones. The occurrences of B. priscus longicornis indicate the Middle Pleistocene, Khazar age of these localities.

Five nearly complete skeletons of small cave bear (Grigor, 1926), described by Borisyak (1930, 1931) as Spelaearctus rossicus, were found near Krasnodar at a depth of 14 m in the sandy loams of the second alluvial terrace of the Kuban. The death and deposition of the animals have been attributed to mudflow by Borisyak.

Girei Quarry. The stratigraphy of the alluvial sediments of the Kuban Plain has been worked out by Gromov (1948) from the sections in the quarries near the village of Girei and the Kavkazskaya railroad station in the town of Kropotkin.

Sandy loams and sands 2 m thick, and greenish loam 1.5 m thick with vertical plant roots have been exposed by quarrying in the 10—15-m-thick Würm terrace of the Kuban. Crossbedded gravels with sand lenses and gravel beds up to 3.5 m thick were exposed in the lower part of the quarry. Bones of mammoth occur at the base of the 3.5-m-thick sequence, which is underlain by a clay bed 0.8 m thick with plant remains (Figure 43), and a sand bed 3 m thick. The sand is underlain by gravels containing bones of bison, deer, and elephant.

92 The following species occur in the gravel beds (Gromov, 1948): Elephas wüsti, E. aff. trogontherii, E. primigenius, Rhinoceros mercki, R. antiquitatis, Bison priscus cf. longicornis, B. priscus deminutus*.

According to the observations of the geologist Kolbutov, the bones of E. wüsti and R. mercki came from the lower gravel bed, which overlies the clays with lignitized wood. The age of these fossils is close to those of the Tiraspol' gravel. The mammoths from the sands and gravels higher in the section are of Riss age, and thus contemporaneous with the "fauna" at the Il'skaya paleolithic locality (Gromov, 1948). The material represents three faunal complexes: 1) post-Khazar with Elephas primigenius, 2) Khazar with E. trogontherii, 3) pre-Khazar with E. wüsti.

According to Gromov, the age of most of the bones from the Girei quarry is Khazar, i.e., Early Riss or Riss-Mindel.

Our studies in 1952 of the locality at Girei revealed the following stratigraphic sequence from top to bottom: surface loams; ancient alluvium, 12-13 m thick; Sarmatian blue clay, 5-6 m of which were exposed by the Recent Kuban River erosion (Figure 44).

Fragments of large tree trunks, often coated with ferruginous silt, saturated with water and charred in appearance, are common in the lower part of the sands and clays at a depth of 10 m. The following trees, which
93 are characteristic of the present foothills, have been identified: oak (Quercus sp.), beech (Fagus sp.), and poplar (Populus sp.). Bones occur in the gravels overlying the wood-bearing sands. Most of the bones are well-rounded, heavily permineralized and iron-stained.

(92)

FIGURE 43. Gravels and sands (stripped of loam surface) in the Girei quarry

Photograph by author, 1952

We identified elephant teeth from the Girei quarry, now in the Krasnodar Museum, as follows: Elephas meridionalis — two molars with enamel 3.5-4 mm thick; E. trogontherii — three molars with enamel 2.4-2.8 mm thick; E. trogontherii primigenius — one tooth with enamel 1.8-2.2 mm thick. The bone material in the teeth of the meridionalis and trogontherii species is pink-tinged beige and resembles marl. The state of preservation is comparable in both species. A tooth of an early mammoth with 8.5 enamel lobes over 10 cm on M^3 is in a better state of preservation: in fracture the bone material is white, black-veined and slightly iron-stained. The collections also include bone fragments of deer (Cervus elaphus) and a marl-like fragment of a horn stem of Bison cf. schoetensacki.

The sandy-gravelly sequence at Kavkazskaya contains an assemblage consisting of animal remains which have been eroded and redeposited by lake sediments of different ages. As a whole, the Elephas meridionalis — E. trongotherii complex is possibly somewhat younger than the Taman faunal complex (see Chapter I). In all probability, there were no antelope in the younger complex: the bison were larger than the Taman species, and the deer were less diversified than those in the earlier complex.

The bones of mammals which are infrequently found in the upper parts of the loess and in the fossiliferous soils underlying the loess on the water divides of northwestern Ciscaucasia are attributed to a later time. The Middle Pliocene localities in the lake sediments near Krylovskaya and Skobelevskaya are exceptions to this dating. Mirchink (1936b) has correlated the upper

* The material was lost during the war.

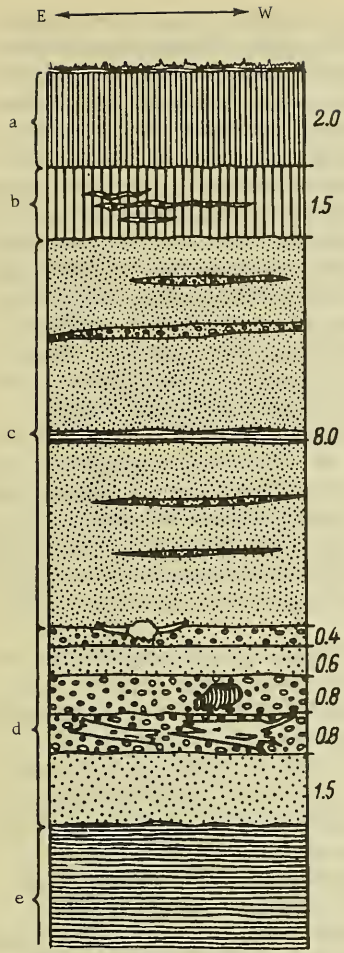

FIGURE 44. Section through bone-bearing gravels and sands in the Girei quarry

a — surface loams; b — sandy loam with gravelly intercalations; c — river sands with layers of gravels and clays; d — gravels and sands with mammalian bones and tree trunks; e — Sarmatian blue clays. On the right — thickness in meters

part of the loess in Ciscaucasia with the Würm glaciation, and the fossil soils with the Riss-Würm interglacial.

The Basal Quaternary of the Trans-Kuban Plain is represented by the middle part of the Psekups gravels with E. meridionalis, Equus stenonis and unidentified Bos (Gromov, 1948).

The meridionalis and trogontherii elephant species are usually dated as the Lower or Middle Pleistocene. These occur, as a rule, in the highest terraces of the left tributaries of the Kuban. A tooth from the mandible of Elephas trogontherii was found near the village of Pregradnaya on the Bolshoi Zelenchuk (ZIN collection).

The Trans-Kuban Plain collections in the Krasnodar Museum include elephant molars of a species intermediate between Elephas trogontherii and E. primigenius. The tooth enamel is 1.8-2.4 mm thick; it forms 7-8 lobes over 10 cm of the upper surface. The iron stain on the bones indicates that the remains of the elephants were buried in fine-grained river and lake sands, which subsequently became marshland. As for their state of preservation, these teeth always look younger than the teeth of E. meridionalis from the Psekups and Taman; the dentine and cement are dense and light beige and yellowish in color. In the gravel quarry near the village of Nekrasovskaya on the Laba, the following forms have been identified: tooth of an elephant of the type intermediate between E. meridionalis and E. trogontherii; lower molar of Equus aff. süssenbornensis; fragment of a horn of the deer, Euclado-cerus sp.; and a fragment of a horn of a giant deer, Megaceros euryceros. The faunal composition, the mode of preservation and the iron stain on the bones at this locality resemble some deposits on the Taman Peninsula.

More recent collections by the Krasnodar Museum from the gravel quarry near the village of Ivanovskaya include molars of true mammoths with enamel 1.4-1.8 mm thick and 12 lobes over 10 cm. A molar of a mammoth was also found on the Pshish River. Teeth of Elephas meridionalis and E. trogontherii from the vicinity of the village of Novo-Labinskaya on the Laba River are in the Maikop Museum collection.

The museum material is difficult to place stratigraphically because of inadequate labelling and the peculiarities of the mode of deposition on the piedmont plain (see above). On the plain, cones of silt debris, formed out of mudflow and carrying the bodies of animals, were deposited one on top of the other. However, these deposits were later eroded by rivers which redistributed the bones in aggradation terraces. In this way, faunas of quite different ages occur in the same river terraces, and, for this reason, Mirchink's (1936b) attempted synthesis of the geomorphological and paleontological data on the river terraces of the southern Russian Plain and of Ciscaucasia can be accepted only with great reservation. On the basis of the occurrence of *Elephas planifrons* teeth, Mirchink dated the 175 m terrace near Cherkessk Pliocene in age. The 100-125 m terrace belongs to the Mindel glaciation period, according to Reingard. On the Kuban Plain, this terrace is overlain by two loess strata. Two layers of osseous soil, correlated with the "*Paludina* sands" near Taganrog, Bessergenovka and Yeisk, occur here. The 50 m terrace near Cherkessk has been correlated by Mirchink, without paleontological evidence, with the moraines near the village of Khumarinskoe and the lower loess horizon occurring on the water divides of western Ciscaucasia. The loess, according to Mirchink, is of Riss age. It is likely that the loess in Ciscaucasia correlates with the gravels at the base of the
95 second terrace in the lower Volga. Fossils of the Khazar faunal complex occur in these gravels.

Il'skaya Paleolithic site. The activities of Paleolithic man in western Ciscaucasia are traceable through flint tools which occur on the shoals of the Kurdzhips and Belaya rivers near Maikop and Fortep'yanovka. The area probably had many summer encampments. The caves in the foothills, mentioned in local accounts, have not as yet been investigated by paleontologists. The Fanagoriiskaya cave, a narrow, cold crevice cut through the limestone conglomerates by the upper Ayuk rivulet west of the village of Goryachi Klyuch, was unsuitable for large animals.

The Il'skaya site was discovered in 1898 by Debaille (see Volkov, 1899). This is an open site on the right bank of the Il', the left tributary of the Kuban, 40 km southwest of Krasnodar. The site, now in deforested foothills, was rediscovered in 1925 by Zamyatnin (1934) who carried out excavations in 1927-1928, and who was followed by Gorodtsov (1940) in 1930 and 1936-1937.

Paleolithic remains occur in the lower of two beds of fossil soils in diluvial loams located on the second 10-14 m terrace of the Il' under the dolomite cliffs.

The archaeologists mentioned above have described numerous tools found at the site made of dolomite and, occasionally, of flint. Because of the poor finish of the dolomite tools, Zamyatnin dated the site Mousterian, but the more refined finish of the flint tools led Gorodtsov to date the site Solutrean. The geological dating of the terraces is Riss-Würm, Early Riss (Gromov, 1933, 1948).

According to Gorodtsov, the community abandoned the site when the surface of the Riss terrace became bogged at the onset of diluvial processes. At the same time oil seepage from the dolomite displaced the water at the site and preserved the strata containing Paleolithic tools and bones. The state of preservation of the bones varies at the Il'skaya site. Some

fragments "jingle" and are so thoroughly permineralized that they only stick slightly to wet fingers; their specific gravity is almost equal to that of Pliocene bones. These bones are usually strongly stained with the iron oxide which fills the pores, or are covered with particles of silty fine-grained sand of a type characteristic of swampy springs on river floodplains. The enamel of the teeth is completely black. Those bones which were preserved in oil are younger in appearance. All the collected bones are food remains — the epiphyses on the bones are broken off, and the diaphyses split as though bone marrow has been extracted. Fragments of jaws and individual teeth of bison are particularly abundant and bones of young mammoths, showing teeth impressions of large carnivores, also occur at the site.

When the asphalt which adhered to the teeth of the bison was dissolved with benzine, the remains of birch mice, small snakes, beetles and grasses became visible.

96 Table 7 and Figure 45 give the species and their number in the Zamyatnin and Gorodtsov collections, as identified by Gromova (1932a, 1937) and by the author.

TABLE 7. Mammals from the Il'skaya site

Species and higher taxa	Number of bones	Number of individuals
Ursus spelaeus	2	2
Canis aff. lupus (small form)	19	4
C. lupus	1	1
Crocuta spelaea	24	7
Elephas primigenius	210	5
Lepus aff. europaeus	15	1
Sicista cf. caucasica	2	2
Muridae, not determined below generic level	9	2
Equus caballus	13	5
E. cf. hidruntinus	23	3
Sus scrofa	1	1
Cervus elaphus	33	4
Megaceros euryceros	37	4
Bison priscus	2,401	43
Saiga tatarica	38	2
Artiodactyla, not determined below generic level	549	—
Total	3,377	86

The absence of woolly rhinoceros, elk and mountain goat is probably not accidental. These animals were rare and difficult to hunt.

Elasmotherium and camel, common in the Middle Pleistocene of the Volga River region, either did not exist on the Trans-Kuban Plain, or, at most, were extremely rare.

Bison remains account for 87% of the bones at the Il'skaya site. The species, according to Gromova, is one of the forms showing reduction in size: Bison priscus deminutus.

In fact, relatively small molars and carpal bones (of cows?) occur along with bones of large bison, which are indistinguishable from those of Khazar age of the middle and lower Volga. The proportion of large bones is small,

(98)

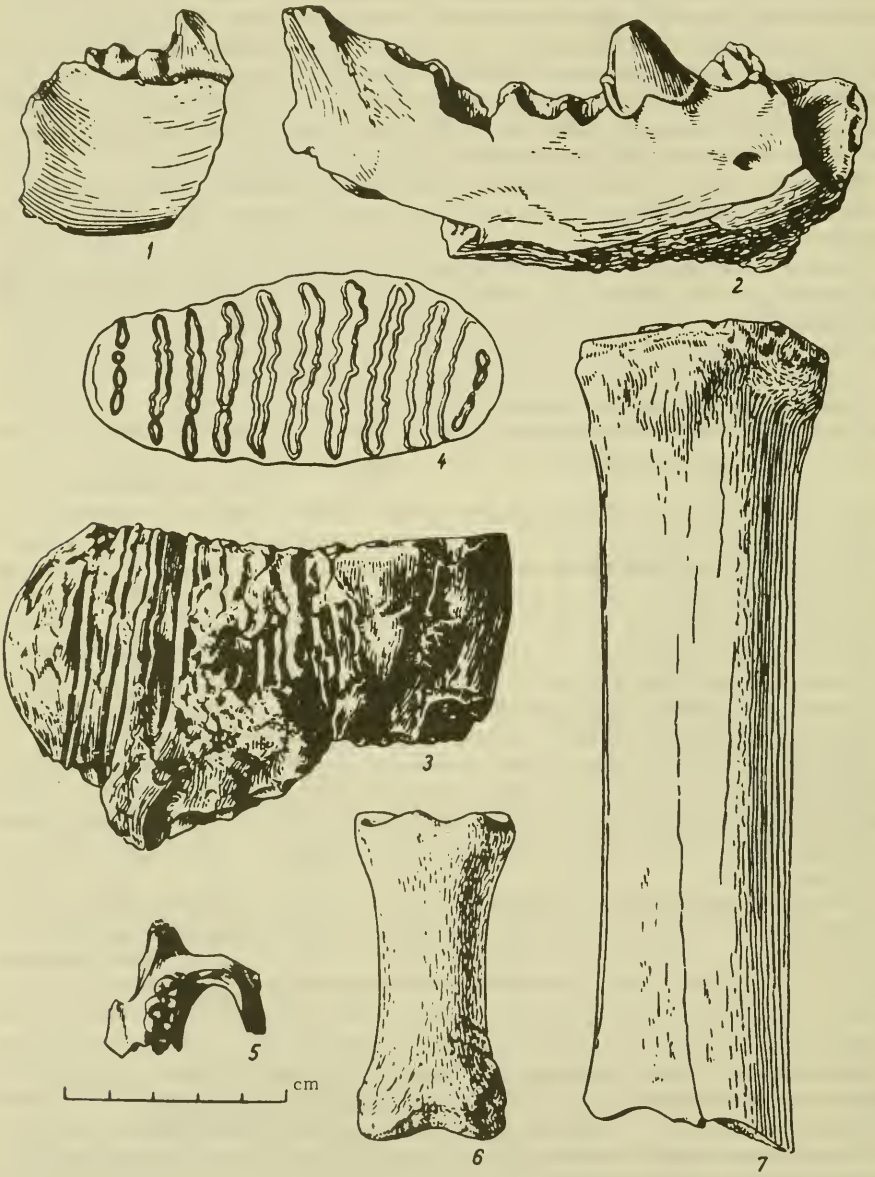

FIGURE 45. Mammal remains from the Il'skaya site

1 — jaw of Canis lupus; 2 — jaw of Crocuta spelaea; 3, 4 — M_4 of Elephas primigenius showing worn surfaces; 5 — upper jaw of Sicista cf. caucasica (×8); 6 — phalange of Equus hidruntinus; 7 — metacarpus of E. caballus;

but the determinant here may have been the selectivity of the ancient Trans-Kuban hunters rather than any morphogenetic factor. It is possible that hunters might have killed cows in preference to bison.

The surroundings of the site were probably meadow- and forest-steppes, which were inhabited by large herds of bison, horse and deer.

The climate and landscape of the Trans-Kuban region in the Upper Pleistocene can be best inferred from the presence of saiga and boar. Saiga did not live on the left bank of the Kuban in historical time, because of the damp summers and snowy winters which prevailed there. Boar, however, survived until recently by descending to the forested plain after heavy snowfalls in the mountains. Thus it can be seen from the evidence at the Paleolithic site that the Trans-Kuban area was more of a steppe than it is at
97 present; the climate was drier, and there were no catastrophic snowfalls. However, the saigas could migrate from the north into the foothills only over ice- and snow-covered ground, as they do now in eastern Ciscaucasia.

(99)

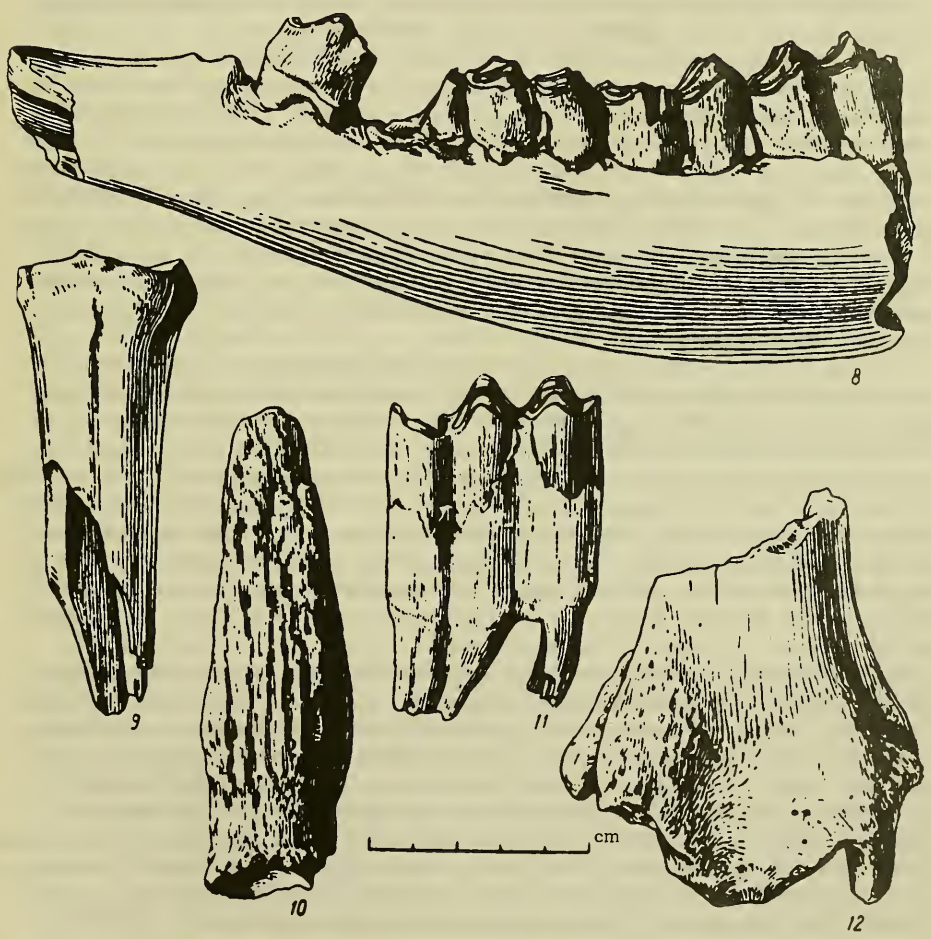

FIGURE 45 (continued)

8 — jaw of Megaceros euryceros; 9 — metacarpus of Cervus elaphus; 10 — horn stem of Saiga tatarica; 11, 12 — M_3 and epiphysis of shank bone of Bison priscus.

The negligible number of boar bones is probably accounted for by the much higher altitude of the mountain forests at that time. The absence of rock and mountain animals — mountain goats, sheep and boreal mammals — is also highly indicative.

The absence of mountain goats, however, cannot be used in dating this site and estimating the extent of glaciation in the Caucasus. Even during the maximum extent of glaciation, these animals could have lived along the margins of the mountain glaciers near the Semashkho and Oplenen peaks, 60-70 km from the site, and well outside the regular hunting grounds of the Il'skaya hunters. The mountains close to the site were low and gently sloped. The absence of the arctic fox, reindeer and ox indicates, most likely, that these species did not reach the northern Caucasus.

The elephant bones at the Il'skaya site belong to a mammoth of a late type (tooth enamel thickness: 1.3-1.4 mm). At least two adults and three young, at the stage of tooth growth — M^3-M^4, were found.

New collections of the bones of smaller species, which are preserved at the site in asphalt crusts, would contribute much to the understanding of the evolution of the Quaternary fauna in the Caucasus.

Fragments of insect chitin which fell into the oil pools at the site and were thus preserved, were examined at our request by Bogachev, who identified eighteen beetles, one ant and one wasp (?). Of the beetles, the most common are water scavengers and water beetles (Dytiscus sp. nov., Agabus sp., Illibius sp., Hydroporus sp., Colymbetes fuscus L.); others are ground beetles (Carabus sp. nov., Platysma sp., Amara sp., Bembidium sp.), leaf beetles (Gastroidea sp., Donacia sp.) and Coprinae (Aphodius subterraneus L.). The steppe forms are represented by Tentyria nomas Pall. Many of the species differ considerably from the Recent forms, which indicates the antiquity of this fauna.

Among the 20 grasses preserved in chunks of bitumen, collected by Zamyatnin and studied by Kipiani, the following predominated: Cruciferae gen. et sp., Compositae gen. et sp., Lepidium perfoliatum, Polygonum aviculare, Euphorbia cf. palustris, cf. Statice, Chenopodium sp. et cf. Atriplex. There were also occasional remains of Alisma sp., cf. Carex, Scirpus sp., Plantago sp., and other forms. No macroscopic remains of arboreal species were recorded. The species listed are ancient, weedlike types, characteristic of sunny habitats and some of them of a shallow-water environment. Cherdyntsev has set the age of the Il'skaya site from the carbon-dating of the bones at 39,000 years.

In our opinion, the Il'skaya fauna indicates the beginning of the Upper Pleistocene and the extensive development of steppes in the foothills region.

In 1957 Formozov carried out exploratory excavations at the entrance to a cave in the Belaya River ravine near the village of Dakhovskaya. He collected eighty fragments of poorly preserved bones and some tools of the Mousterian type from the 3-m level. We have identified the bones as follows: Canis sp. (10/2), Vulpes sp. (17/4), Ursus spelaeus (3/2), Crocuta spelaea (1/1), Meles meles (7/2), Panthera spelaea (4/1), Felis cf. silvestris (2/1), Lepus europaeus (3/1), Cricetus cricetus (3/2), Elephas cf. primigenius (14/1), Cervus elaphus (5/2), Megaceros euryceros (5/2), Capra cf.

caucasica (2/1), Bison priscus (19/3).* This fauna is characteristic of ecological assemblages of the Middle-to-Upper Pleistocene transition. As a whole, it is quite similar to the Il'skaya assemblage. Some small forms of wolf and fox are particularly interesting.

Central Ciscaucasia

On the Stavropol Plateau and in the Pyatigor'e area Pleistocene mammals occur mainly in diluvial loams covering the water divides and filling old
100 gulleys. Older, Lower Pleistocene fossils occur in deposits of ancient streams and marine and lake bays on the surrounding plains. The Lower Pleistocene material is represented by Elasmotherium sibiricum from the vicinity of Divnoye in the Manych depression(Pavlova, 1916), and by Equus cf. stenonis teeth from loess loams near the village of Mirnyi (Khomenko, 1913a). The following finds can be dated Middle Pleistocene, Khazar: horn of Megaceros hibernicus, found by Khomenko in diluvial clays in the Kalaus cliffs; Saiga prisca (= S. tatarica) from diluvial clays in the Koronkoyar gulley, 35 km south-southwest of Stavropol; Equus caballus fossilis, in diluvial clays of the Shatyr mound, and remains of Bos sp. from sands at the bottom of a well in the stream bed of the Mutnyanka.

The collection of elephant teeth in the Stavropol Museum includes three lower molars (7 lobes over 10 cm; enamel thickness 2.5-2.8 mm) of Lower Pleistocene Elephas trogontherii. The museum collections also contain six fragments of long-horned bison skull and one fragment of skull of a primitive bull (Bos primigenius) which was found in the Stavropol area. Most of the material was collected from beds underlying the loess loams and can be dated Middle Pleistocene.

New materials were collected by Gnilovskii in 1941 on the Kuban-Yegorlyk canal on the western edge of the Stavropol Plateau. The following specimens were collected from a 6-m depth of the first terrace of the Yegorlyk: two fragments of mandible, a lower carpal epiphysis and a heel bone (bitten through by some carnivore) of Paracamelus cf. gigas; fragmentary bones of short-horned bison; and fragments of neck vertebrae, horn, forelimb bones and astragalus of Bison cf. schoetensacki. The bones are chalky in appearance, with light iron oxide stains along the cracks.

The following bones were collected from a 9-m depth in the alluvial bed overlying the Maikop clays in the first Yegorlyk terrace: fragments of upper molars of bulls (Bos sp. or Bison sp.) and an upper molar and first phalanx of a small horse (Equus sp.). The bones, which are iron-stained and not rounded, occur on the erosional surface and are probably Lower or Middle Pleistocene.

Ryabinin's (1918) collections from the Udel'naya steppe of the upper Kalaus are of Upper Pleistocene and partly Holocene age. The material was collected from the upper part of the loess loams exposed in the left bank of the Malyi Kiyankul' gulley, at the upper end of the Pervaya Ternovaya gulley, and in the Kalaus stream bed near the opening of the

* The numerator indicates the number of fragments; the denominator, a possible number of individuals.

Malyi Yankul' gulley. At the Malyi Yankul' locality numerous mammal bones occur at a depth of 2.5 m in the structureless brown, sandy, gypsiferous clay with small, limey concretions. Ryabinin has identified the following forms: "Equus caballus fossilis, Sus scrofa fossilis, Bos taurus fossilis, Saiga tatarica fossilis and a horn similar to those of goitered gazelle (Gazella subgutturosa)." Mesolithic tools (of the Solutrean or Magdalenian cultures," according to Ryabinin) collected at the locality indicate the last part of the Pleistocene or even the transition to the Holocene.

101 Thus, the fauna of the margins of the Stavropol Plateau does not support the hypothesis that mountain mammals of the Caucasus migrated to the plains during the maximum glacial advance. No boreal species have been recorded in the area. Studies of the caves on the southern and western slopes of Mount Strizhament (Vereshchagin and Gromov, 1953b) would contribute to the knowledge of the steppe and forest-steppe complexes of the Stavropol area of the Upper Pleistocene.

Bones of a mammoth have been recorded from gravel quarries near Yessentuki in the region of the Pyatigor'e laccolith on the Kabarda sloping plain (Karpinskii and Dreier, 1904). Eikhwal'd (1850, p. 190) reported finding near Kislovodsk the complete jaws of a primitive form of Equus caballus covered with tuff.

Travertines of the Pyatigor'e area. Travertines were deposited in post-Pliocene Pyatigor'e by mountain springs, which changed course after each mountain-building cycle. Animal remains were shifted and scattered by carnivores over the slopes until they became covered by sediment. Layers of lime-tuff formed on the bones upon contact with water rich in calcium-carbonate.

Travertines were deposited on almost all the laccoliths — Lysaya, Zheleznaya, Zmeika and Beshtau. However, only the travertines of Mount Mashuk have been subjected to paleontological study (Ivanova, 1948; Mirchink, 1936b; Gromov, 1948).

According to Ivanova, there are four stratigraphic complexes of travertines: the first of Pliocene age (see Chapter I), the other three of Pleistocene and Holocene age.

The travertines of the second complex (Mindel and Mindel-Riss age) occur in patches on the northern and eastern slopes. Teeth and jaw fragments of Elephas aff. antiquus have been found in these travertines. The travertines of the third complex cover a larger area to the northeast. These travertines have been correlated with the 55-m Riss and Riss-Würm terrace of the Podkumok, where numerous bones of deer (Cervidae) occur. The fragments of Lepus sp. and Capreolus sp. teeth, collected by Kobutov in the Boichenko quarry, probably come from the travertines of the third complex. The material is Upper Pleistocene in appearance.

The travertines of the fourth (Upper Pleistocene to Recent) complex occur in the first and second terraces on the southern slope of a mountain near Pyatigorsk, which extends to the stream bed of the Podkumok. According to Gromov (1948), the teeth of an advanced type of Equus sp. and of Elephas primigenius found in the gravels and loams of the second (Würm) terrace originally came from the travertines.

The Pleistocene collections in the Pyatigorsk Museum include a sample of dolomitized travertine with a calcitic mold of a horn of a small bison (Bison sp.). Also in the museum is a fragment of the upper jaw of a mammoth with the third milk tooth, collected from quarry No. 1 on the northern slope of Mount Mashuk. The fresh appearance of the bone is very unusual among fossil findings in the south and suggests that the Pyatigor'e mammoth died as recently as the Holocene. The fragment of mammoth upper molar found in the travertines near the Medovyi waterfall in the
102 vicinity of Kislovodsk, the mammoth teeth found in the sands and loams near the village of Kamenskaya, and those found at a 12-m depth in the banks of the Yutsa River are all older in appearance. The museum collections also include two jaws of woolly rhinoceros (Rhinoceros tichorhinus) and six skull fragments of primitive bison. The state of preservation of this material is Upper Pleistocene.

All these fossils from the alluvial and diluvial sands and loams of the sloping Central Ciscaucasian Plain give only a very schematic picture of the ecological assemblages of the mammoth fauna which lived near the mountains. In the Lower Pleistocene the region was undoubtedly a steppe. At the end of the Pleistocene, however, the region became forested, at least in Pyatigor'e as indicated by occurrences of deer and gazelle bones in the travertines of the third complex of Mount Mashuk, and by the occurrences of post-Pliocene "flora." Krasnov has identified 14 species of grasses and trees from the travertines of the Pyatigorsk area — species which are also characteristic of Recent broadleaf forests of the foothills: beech (Fagus sylvatica), filbert (Corylius avellana), white beech (Carpinus betulus), elm (Ulmus campestris), oak (Quercus robur), Norway maple (Acer platanoides) and other forms. The "flora" from Mount Zheleznaya, which is similar in composition, though somewhat later in age, was identified by Palibin (1913) as follows: willow (Salix alba and other species), linden (Tilia cordata), ash (Fraxinus excelsior) and medlar (Mespilus germanica). No boreal elements have been recorded at these Upper Pleistocene or Lower Holocene localities; on the contrary, the southern elements are more abundant in the floras.

Eastern Ciscaucasia

Most of the plain in eastern Ciscaucasia was covered by the Caspian transgression, which accounts for the scarcity of Pleistocene mammals in the sediments of the plain.

The semideserts and steppes in the lower reaches of the Kuma, Terek and Sulak were in the zone of subsidence. The postglacial marine and river sediments of the area are at present below the base of river erosion. As a consequence, the only known fossiliferous localities with Pleistocene mammals are situated farther west on the high terraces along the shores of Pleistocene bays, on the piedmont plain and in the foothills.

The sloping plains of eastern Ciscaucasia are covered by diluvial sediments and the alluvium of the Terek, Sunzha, Sulak and other rivers. The relief of this area is more complex than that of western Ciscaucasia

as a result of uplift of the Terek and Sunzha ranges during the Tertiary and erosion and further peneplanation during the Pleistocere. These ridges now separate the Vladikavkaz [Ordzhonikidze] and Sunzha plains from the alluvial plains of the western Caspian region.

As early as 1886, Pohlig mentioned mammoth bones from the Sunzha valley in the Caucasian Museum collection in Tbilisi. Mullaev (1929) described a tooth of Elephas trogontherii from the post-Tertiary beds on the Ursdon River near the village of Karagach in the southwestern corner of the Vladikavkaz Plain. Scapula fragments of E. trogontherii from the 5-m level of the Mozdok sand quarry are in the collections of the
103 Pyatigorsk Museum. Teeth of E. trogontherii of an early type from the Grozny Region are in the collections of the Grozny Museum. All the fossils came primarily from Lower Quaternary alluvial sediments.

Gromov (1948) recorded two skulls of Bison priscus deminutus and a fragment of a Megaceros sp. skull from the first terrace of the Terek near Mozdok. The cranial cavities of the bison skulls were filled with volcanic ash. This fact establishes the time of the fossils as the time of deposition of the volcanic ash which occurs under the gravels of the first terrace and on the face slope of the second Riss terrace on the eastern slope of Mount Mashuk.

It seems possible that, in the last outburst of volcanic activity of the Kazbek and Elbrus in the Upper Pleistocene, animals were sometimes killed and buried in the ash deposited by torrents. Of the fossils from the Kuma valley below Budennovsk, a lower molar of a mammoth is included in the collections of the Pyatigorsk Museum. The Upper Pleistocene fossils are represented by fragments of Sus scrofa ferus mandibles collected by the geologist Plamenevskii in the alluvial sediments of the first (Würm) terrace on the right bank of the Terek above Ordzhonikidze.

Generally speaking, the evolution of landforms and faunal complexes was similar in eastern and western Ciscaucasia. The same large mammals occur in the Lower and Middle Pleistocene — Elephas trongotherii, giant deer, primitive bison and — in the Upper Pleistocene — boar.

Forests were probably well developed in the Upper Pleistocene along the lower northern slopes of the Caucasus, and even in Dagestan. Whitebeam (Sorbus aria) and European hornbeam (Carpinus betulus) have been identified by Palibin (1913) as "post-Tertiary" species from the foothills near Makhachkala. These species also occur in the area at the present time.

Very few fossil mammals are known from the piedmont and inner parts of Dagestan, or from the marine terraces of the western coast of the Caspian Sea, from Sulak to the Apsheron Peninsula. The collections in the museum at Makhachkala contain tooth fragments of Elephas trogontherii of an early type (enamel thickness 2.5-3.0 mm) from the ferruginous gravels of the Manas River. A tooth fragment of a more recent elephant, with features of Elephas primigenius, and the atlas of an elephant from the vicinity of the village of Unty are in the same collections.

Investigations of Paleolithic sites and excavations of caves and sheltered areas in the Apsheron limestone above Makhachkala and inner Dagestan would contribute to a better understanding of the evolution of Middle and Upper Pleistocene fauna in this part of the country.

Western Ciscaucasia

In western Ciscaucasia the Pleistocene mammals occur mainly in cave deposits, kitchen middens and food remains of carnivores.

Other types of deposition are seldom found. Several factors account for this: a lack of sedimentation and a rapid stream-flow which destroyed the bones, a humid climate which induced rapid decay of bone material, and the rapid
104 subsidence of the sea bottom in coastal areas which precluded the formation of deltas.

Some occurrences are known from terraces and from small reed and sphagnum marshes and lakes which still exist in the region of Sochi, Pitsunda, and Ochamchiri. Some of these localities were later uplifted and exposed by river erosion. There are extensive alder and sphagnum marshes along the lower Rion and Supsa (Poti, Kobuleti) in the area of the Colchis depression which is at present rapidly subsiding under the load of river deposits. Without artificial excavation, whatever fossil mammals occur in those beds will remain there for centuries to come, practically inaccessible to study.

The tooth of *Elephas primigenius* Blum. in the Sochi Museum (mentioned by Gromov, 1948) might have been introduced into the area.

Ryabinin (1937) has described a fragment of the right half of the mandible of a large cat, similar to *Felis* cf. *spelaea*, found in 1935 6 km north of Sochi. The mandible was taken from the gravels of the third marine terrace (Karangat) and originally dated Riss-Würm. More recently it was identified as Early Riss (Vardanyants, 1948). Shells of *Cardium*, *Tapes* and *Mactra* occur in the same terrace.

The Black Sea coast of the Caucasus was favored by Paleolithic hunters for its propitious conditions for big-game hunting: numerous narrow valleys and canyons, coastal terraces which carried the free migration of ungulates both from the north and from the south, and many caves inhabited by bears.

The uplift of the spurs of the Bolshoi Range in the Pleistocene saved the cave deposits from river erosion. Paleolithic sites occur along the foothills from Sochi and Tuapse in the north to Kutaisi and Batumi in the south and the east. Paleolithic deposits probably continue along the northern coast of Asia Minor.

Zamyatnin (1937a) has described and mapped 43 Paleolithic localities in Abkhazia. He subdivided the sites into three chronological groups: 1) pre-Mousterian, 2) Mousterian, 3) Upper Paleolithic. Most of the sites, however, are represented by only a few flint tools.

Efimenko and Beregovaya (1941) have listed 15 open sites and 14 cave sites in western Georgia.

Fossil mammals are known only from cave deposits in the gorges of the Khosta, Kudepsta, Mzymta, Tsebel'da, Rion, Kvirila and other smaller rivers.

Caves on the Black Sea coast

In 1936-1938 Zamyatnin (1940) excavated the Navalishinskaya and Akhshtyrskaya caves in the Sochi and Adler area in the Krasnodar Territory.

Navalishinskaya cave is near the village of Navalishino, 12 km from the sea, on the right bank of the Kudepsta. Two cultural layers were found in the cave: the upper layer (Upper Paleolithic) with bones of hamster and redeposited bones of cave bear; the lower layer (Mousterian, Aurignacian), with bones of elk, goat, hamster, cave bear, wolf, birds
105 and shells of Anodonta and Helix. According to Zamyatnin, the cave was merely a seasonal shelter of early man.

The mammals from the cave were identified by Gromov (1948), as shown in Table 8.

TABLE 8. Species and number of bones of mammals from the Navalishinskaya cave

Species	Middle Paleolithic	Upper Paleolithic
Canis lupus	1	—
Ursus spelaeus	165	229
Cricetus cricetus	—	1
Alces alces	—	1
Capra sp.	1	1
Total	167	232

The Shirokopokosskaya cave (which Gromov called Navalishinskaya II) is located near Navalishinskaya I. It contained Upper Paleolithic tools, cave bear bones and a few bones of red deer (Gromov, 1948).

Bones of cave and European brown bear were excavated in 1946 in the Vorontsovskaya cave in the Khosta ravine (collection of the Krasnodar Museum). The state of preservation of the cave bear bones is not uniform: in fresh fracture the mandible bone is brownish and free of organic matter. The radius and femur are dark brown, and show little loss of organic matter; when scraped, they exude an odor of fresh bones. It seems that the cave bear lived in postglacial times.

Akhshtyrskaya cave is located on the right bank of the Mzymta River 100 m above the river bed at the point where the river leaves its narrow canyon, near the village of Akhshtyr, 15 km from Adler (Figure 46), and is, at present, inhabited only by bats (mostly horsehoe bats). The entrance to the cave faces south and a corridor 4.35 m high, 2 m wide and over 100 m long leads to the cave, which was probably much lower in Paleolithic time. In front of the corridor is an overhead ledge and two entrances with two platforms. The eastern platform has been excavated by Zamyatnin (Figure 47). From the west the cave can be approached over a narrow, easily defended trail on the cliff. Zamyatnin assumed that it was intermittently inhabited by man over several millennia. Because of the elevation of the platform dwelling site, the inhabitants probably threw away most the bones and tools into the river. In the intervals between man's occupancy, bears and bats lived in the cave. Two narrow crevices, which were also inhabited by bears, are located farther west and down the cliff.

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