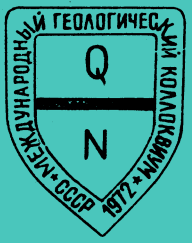
INTERNATIONAL COLLOQUIUM ON THE NEOGENE QUATERNARY BOUNDARY

GUIDEBOOK



MOSCOW 1972

INQUA Subcommission on the Pliocene-Quaternary Boundary

IUGS Subcommission on Neogene Stratigraphy

Geological Institute of the Academy of Sciences of the USSR

Department of Paleontology and Stratigraphy of the Academy of Sciences of Moldavian SSR

Institute of Paleobiology of the Academy of Sciences of Georgian SSR

Institute of Geology of the Academy of Sciences of Azerbaijan SSR

Azerbaijan Research Design Institute of Oil Prospecting

G U I D E B O O K

Excursions in Moldavia, Georgia, Azerbaijan May-June, 1972

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Moscow 1972

CONTENTS

F O R E W O R D

The Colloquium is proceeding under the authority of the INQUA Subcommission on the Neogene-Quaternary Boundary and IUGS Subcommission on Neogene Stratigraphy. The Colloquium is organized by the Geological Institute of the Academy of Sciences of the USSR together with the Department of Paleontology and Stratigraphy of the Academy of Sciences of the Moldavian SSR, Institute of Paleobiology of the Academy of Sciences of the Georgian SSR, Institute of Geology of the Academy of Sciences of the Azerbaijan SSR, Azerbaijan Research Design Institute for Oil Prospecting.

The aim of the Colloquium is to discuss the position of the boundary between the Neogene and Quaternary on the basis of geological and biostratigraphical data (fauna of mammals, marine and fresh-water mollusks, foraminifera, ostracod, leaf flora, spore-pollen analysis) and the data of physical methods of study (paleomagnetism, absolute age) on various continents of the Globe.

The second part of the Colloquium is devoted to excursions on the areas of Moldavia (lower parts of the Prut and Danube basins), East Georgia (locality Kvabebi - basin of the Iory river) and West Azerbaijan (localities Kushkuna and Duzdag). The schemes of the routes are given at the beginning of corresponding chapters. On the area of Moldavia the participants of the Colloquium will be shown the sections of alluvial deposits of the so-called "Moldavian Russilion", characterized by the fauna of the Moldavian complex, as well as terraces IX, VIII, VII and V of the Prut and Danube rivers containing faunas of the Khaprovian, Tamanian and Tiraspolian complexes. In addition to, the dele-

gates will be shown sections of cover deposits with some buried fossil soils corresponding to alluvial deposits of heterochronous terraces.

On the area of East Georgia and West Azerbaijan one can see the sections of Akchagylian and Apsheronian marine deposits containing the mollusk fauna remains of the mammal fauna of the Moldavian, Khaprovian and Tamanian complexes. The age of deposits is given in the Guidebook according to the scheme officially adopted in the Soviet Union. Along with, the interpretation of the age of deposits is given in accordance with the scheme by V.I. Gromov, I.I. Krasnov, K.V. Nikiforova and E.V. Shantser (1969).

This guidebook was compiled by the following authors: Moldavia - N.A. Konstantinova, K.N. Negadaev-Nikonov, K.V. Nikiforova, M.A. Pevzner, A.N. Khubka, A.L. Chepalyga, A.G. Chernyakhovsky. East Georgia - D.A. Buleishvilli, A.K. Vekua. West Azerbaijan - A.A. Ali-Zade, K.A. Alizade, D.A. Aleskerov, E.M. Asadullaev, N.A. Lebedeva.

Vertebrates remains have been determined by L.I. Alexeeva, L.P. Alexandrova, V.E. Garutt, V.I. Gromov, I.M. Gromov, A.I. David, I.A. Dubrovo, V.A. Topacevski, L.I. Khozatsky and K.I. Shushpanov; those of mollusks - by G.I. Popov and L.A. Chepalyga; ostracods - by K.N. Negadaev-Nikonov and G.F. Shneider. The mineralogical composition of alluvial and cover deposits has been studied by N.V. Rengarten and A.G. Chernyakhovsky.

The mammal fauna from Kvabebi section of East Georgia has been defined by A.K. Vekua and L.K. Gabuniya. That from West Azerbaijan sections - by L.I. Alexejeva, V.E. Garutt, V.I. Gromov. The fauna of Akchagylian and Apsheronian mollusks from Georgian and Azerbaijan sections has been described according to data presented by A.A. Ali-Zade, D.A.

Aleskerov, K.A. Alizade, E.M. Asadullaev, D.A. Buleishvili, B.P. Zhizhchenko, A.G. Eberzin. Paleomagnetic study of continental sections of Moldavia and those of marine Akchagylian and Apsheronian in Azerbaijan has been carried out by M.A. Pevzner.

The Moldavian sections were thoroughly studied for the first time by N.A. Konstantinova (1965, 1967).

The remains of terrestrial mammals in Akchagylian and Apsheronian marine deposits of Kushkuna and Duzdag (West Azerbaijan) has been discovered by N.A. Lebedeva (Lebedeva, 1970).

The table given below is an attempt to correlate the official scheme of the USSR and that compiled by Gromov, Krasnov, Nikiforova and Shantser (1969) and the scheme of the Quaternary subdivision adopted in Middle and West Europe.

Table

Oficial Scheme of the USSR		Scheme by Gromov, Krasnov, Nikiforova, Shantser (1969)		Scheme of Ponto-Caspian marine deposits	Faunistic complexes	Stratigraphic scheme of Middle and West Europe			Lower boundary according to various authors
Quaternary system	Pleistocene	Anthropogene	Pleistocene			Pleistocene			
				Bakinian	Tiraspolian				C
Neogene	Upper Pliocene		Eopleistocene	Apsheronian	Tamanian			Cromerian	
							Calabrian	Villafranchian: Upper	
				Akchagylian	Khaprovian	Pliocene	Astian / Piacenzian	Villafranchian: Middle	B
					Moldavian			Villafranchian: Lower	
								Ruscinian	
	Middle Pliocene	Neogene	Pliocene	Productive suite (Kimmerian)			Zanclian		A

EXCURSION IN MOLDAVIA

The area of South Moldavia is characterized by wide distribution of Pliocene and Quaternary deposits presented by various genetic types. The sections of alluvial, lagoon and cover deposits divided by horizons of fossil soils are exposed in terraces sections of lower parts of the Prut and Danube valleys. These deposits are perfectly characterized by the mammal fauna, fresh-water and brackish-water mollusks, ostracod and foraminifera. This enables us to regard this area as the key one for the solution of some stratigraphic problems including the Pliocene-Anthropogene boundary.

The route of the excursion is shown in Fig.1.

The greater part of the area of the Prut-Danube interfluve is located on the Epi-Hercynian platform. Two structural stages can be clearly distinguished in a vertical section: basement and cover. Paleozoic and, to a certain extent, Mesozoic (Triassic) metamorphosed and dislocated rocks take part in the structure of the basement. The cover is composed of less dislocated Mesozoic and almost flat-lying Cenozoic deposits. Concerning the depth of occurrence of the basement, the south-western part of the Epi-Hercynian platform located within South Moldavia and south-western Ukraine is subdivided into some blocks (Drumya, Kanikovsky, 1958; Makarescu, 1963) occurring at various depths of about 3000 m, 600-300 and 150 m.

Archean, Proterozoic, Paleozoic, Mesozoic and Cenozoic formations take part in the geological structure of the area concerned.

Upper Pliocene (Eopleistocene) and Quaternary deposits are presented by continental facies. They form terraces of the Prut and Danube rivers and are presented by alluvial and cover formations.

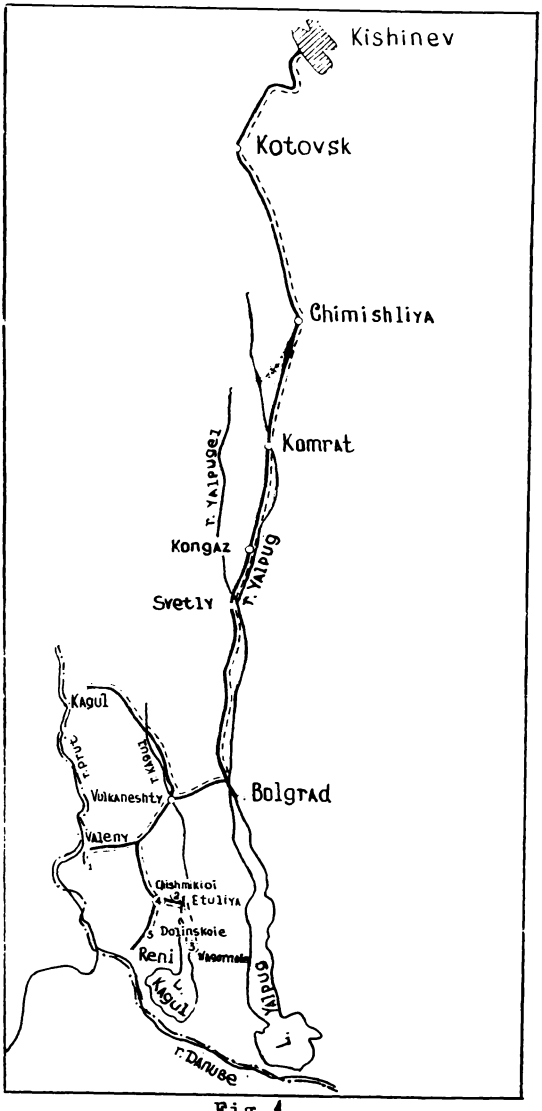


Fig. 1

Scheme of excursion routes in Moldavia.

Alluvial deposits of the Prut and Danube terraces consist of channel pebbles and sands, flood-plain and oxbow-lake sandy loams and muddy loams. The thickness of the alluvium of the Prut terraces is 10-15 m, that of the Danube ones - 15-20 m. Coarse material of old Upper Pliocene (Eopleistocene) terraces of the Lower Prut consists mainly of the Carpathian material, i.e. abundance of fragments of brown, red and grey quartzites, quartzy grains, feldspars; in large fractions frequent are limestone fragments, and in small ones - fragments of pale-green flinty-chloritic shales. All rocks are characterized by a low content of a heavy fraction. In the alluvium of old Danube terraces, in the composition of clastic material of importance are fragments of epidote and hornblende metamorphic slates, quartzites; limestone fragment of pale-green flinty-chloritic shales. All rocks are characterized by a low content of a heavy fraction. In the alluvium of the old Danube terraces, in the composition of clastic material , of importance are fragments of epidote and hornblende metamorphic slates, quartzites; limestone fragments can be observed too. In sandy fractions, besides quartzy grains and feldspars there are many plates of green, brown and colourless micas. Among heavy minerals of these rocks one can record a high content of epidote and hornblende.

Pebbles of Pleistocene terraces of the Lower Prut are presented mostly by local rocks with an admixture of the Carpathian material.

The sandy-pebble material of the Danube Pleistocene terraces differs from that of the Prut; it contains mostly detrital material supplied from the nearest Dobrudzha massif, where the rocks of various crystalline schists, granite, quartzite, etc. had been washed out.

There are various points of view of the number of terraces and the age of alluvial and cover deposits in the Middle

and Lower Prut and in the Lower Danube.

The guidebook gives a scheme of terraces of the Prut and Danube valleys suggested by N.A. Konstantinova (1965).

N.A. Konstantinova established 9 terraces in the Prut valley cut in the Lower Poratian (Lower Levantinian) deposits forming the lacustrine alluvial plane of the Paleo-Prut. In the Danube valley N.A. Konstantinova distinguished 8 terraces, their socles being composed of Upper Poratian (Upper Levantinian) deposits.

K.V. Nikiforova, N.A. Konstantinova, N.V. Rengarten (1965) suggested a scheme according to which the Lower fossil soil lying on the alluvium of any terrace corresponds to the lower part of the alluvium of the next younger terrace. This enables to date not only alluvial, but the cover deposits as well. It has been found out that the Upper Pliocene (Eopleistocene) is characterized by red-brown colour of fossil soil horizons, whereas the Lower- and the lowermost Middle Pleistocene (M, MR) - brown colour.

Fig.2 shows the correlation of alluvial and cover deposits of the Prut and Danube terraces.

Thursday, 25 May, 1972

Route: K i s h i n e v - K a g u l - V a l e n y

Kishinev is the capital of the Moldavian SSR, a large industrial and cultural centre of the Republic. The town is situated on the right bank of the Byk river, the Dniester right tributary. The route begins from the southern border of Kishinev and runs along the picturesque Middle Moldavian Highland called in these places "Kodras" (translated from Moldavian it means "dense forest").

Then the busses pass through the town of Kotovsk, the motherland of the legendary hero of the Civil War, G.I. Kotovsky.

At about 3 kilometers' distance from the town of Bolgrad the road turns round sharply westwards to the village of Vulkaneshty.

Within 1 km of Vulkaneshty from the left side of the road there rises a monumental column 31 m high. It was set up in 1845 to the memory of the Kagul battle on July 21, 1770, when the Russian army, having thirty thousands soldiers only, under the command of P.A. Rumyantsev defeated 150 thousands of Turkish soldiers.

From the village of Vulkaneshty to the town of Kagul the road lies along the right bank of the Kagul river valley.

Kagul is an ancient Moldavian town, an important centre of food industry. During the Second World War in Kagul was acting the underground Komsomol Organization. In the centre of the town there is the monument to its heroes killed during the war.

We are leaving Kagul for the village of Valeny, 300-400 meters from the village toward the south we can see in some ravines, on the left flange of the valley an excellent exposure of Lower Poratian cyclic deposits occurring in the socle of the Prut terrace VII.

Locality 1. Section near the village of V a l e n y (Lower Poratian deposits, "Moldavian Russilion", alluvium of the Prut terrace VIII).

The exposure is located in one of the ravines to the south of the village. The summarized section is presented in Fig.3.

A. The section is described from below upwards. In its lower part composed of Lower Poratian deposits (layers 1-9), each layer is a separate alluvial cycle including some

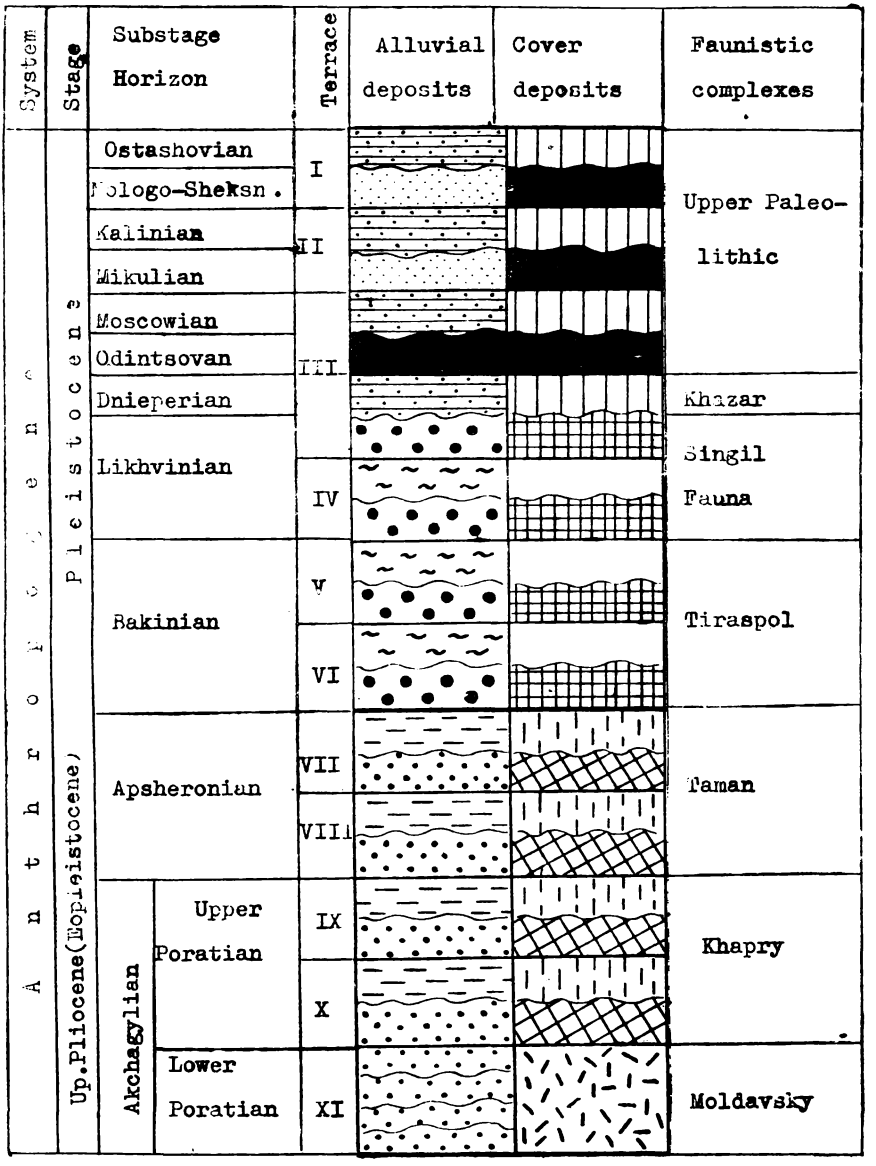
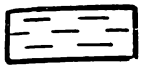
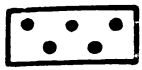


Fig.2. Scheme of relations between alluvial and cover deposits of terraces of the Danube and Prut lower courses.

Lower alluvial suites of the Upper Pliocene (Eopleistocene) terraces.

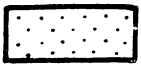


Upper alluvial suites of the Upper Pliocene (Eopleistocene) terraces.



Lower alluvial suites of the Lower and lowermost Middle Pleistocene terraces.

Upper alluvial suites of the Lower and lowermost Middle Pleistocene terraces.



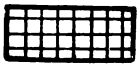
Lower alluvial suites (interglacial) of the Upper Pleistocene terraces.

Upper alluvial suites (periglacial) of the Middle- and Upper Pleistocene terraces.

Weathering crust

Eopleistocene red-brown fossil soils

Eopleistocene deluvial deposits



Lower- and lowermost Middle Pleistocene brown fossil soils

Lower-and lowermost Middle Pleistocene deluvial deposits

Middle- and Upper Pleistocene grey and brown fossil soils.

Middle- and Upper Pleistocene deluvial deposits.

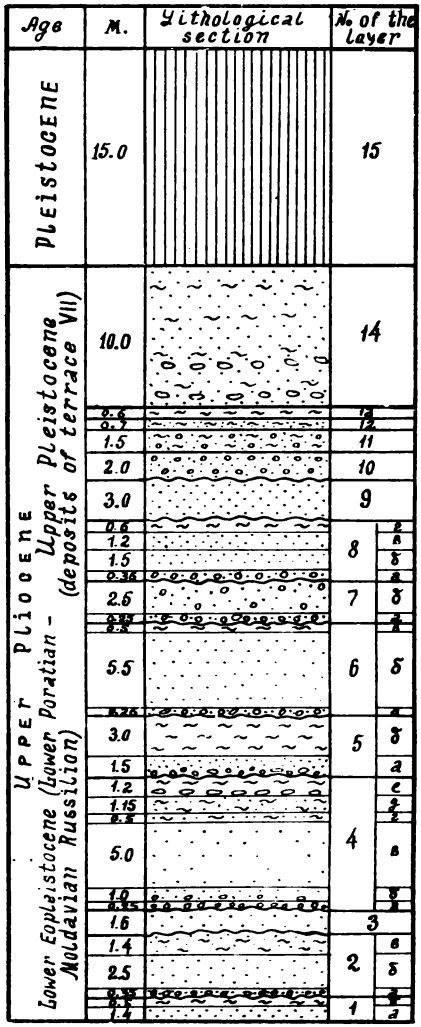


Fig. 3 . Summarized section of alluvial and lagoon deposits of the Prut river terrace VII and Lower Poratian deposits near the village of Valeny

horizons that are designated by letters in the given description.

1. a) Sand, greenish, with ochrous spots, fine-grained, micaceous, quartzy, flat-laminated, slightly clayey, compact, with some horizons of carbonate nodules. The sand is impregnated with pores from plant roots filled with carbonates. Upwards the clay content is gradually increasing.

   Thickness 1.4 m

   b) Clay, greenish-grey, rather dark, with rosty spots, sandy, lumpy, with vertically oriented carbonate nodules. Thickness 0.50 m

2. a) Gravel, consists of Carpathian pebbles, marly concretions and roll-muds in coarse-grained yellow-grey sand. Flat-laminated.

   Thickness 0.35 m.

   b) Sand, yellow-grey, quartzy, predominantly medium-grained, slightly micaceous, flat-laminated.

   Thickness 2.5

   c) Clay, yellow-grey, strongly ferruginated, locally manganous, sandy, lumpy. On the contact with sands, especially on the upper 0.4 m, in the clay there are observed large marly concretions.

   Thickness 1.4 m.

   Erosion

3. Sand, yellow, fine-grained medium-grained, uniform. Visible thickness 1.6 m

   On the other slope of the same ravine there are well seen in layer 3 two horizons with numerous thick-walled large shells of Unionidae. The shells occur horizontally, are oriented upwards with

their convex part and close to each other forming a so-called "shell-pavement". The fauna consists of five species: Margaritifera flabellatiformis (Gr.-Ber.), Potomida sibinensis (Pen.), P. sandbergeri (Neum.), P. bogatschevi (Gr.-Ber. P. nicolaianus (Brus,)[x].

This fauna was discovered here by N. Makarovich (1940). Here, in Lower Poratian deposits, at the hight of 20 m from the foot of the visible part of the section, N. Makarovich found remains of mammals of the Russilion type: Capreolus australis de Serr., Rhinoceros sp. (Leptophinus ?) and Testudo sp.

4. a) Sand, medium-sized, ferruginated, with small green roll muds, lime nodules and a great amount of ferruginous crusts; oblique bedding. The sand contains shells of Lower Levantinian mollusks of poor preservation. Thickness 0.25 m.

In the talus, on the slope below layer 4a were found fragments of an antler.

b) Sand, flat-laminated, coarse-grained, strongly ferruginized and manganous, with marly nodules arranged along bedding. A rare, poorly preserved shell of Lower Levantinian unionides can be found.

Thickness 1.0 m

c) Sand, loose, yellowish and yellowish-grey, fine-grained, quartzy, slightly micaceous, is replaced upwards by light-grey, almost white fine-grained sand with sporadic calcareous nodules arranged along the bedding. Thickness 5.0 m

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[x] The Guidebook follows the systematics of freshwater mollusks given in the paper by A.L. Chepalyga (1967).

a) Sand, light-grey, locally ferruginized, fine-grained, quartzy, slightly micaceous with interbeds of greenish-grey clay that is up to 0.3-4.0 m thick, and roll muds reaching sometimes 0.2 m in cross section. Thickness 0.5 m

e) Sand, greenish-grey, clayey, fine-grained, dusty, slightly micaceous, quartzy, compact, with a great amount of limy nodules and spots of powder lime. When going upwards, the number of limy nodules increases, and the uppermost parts of the layer (0.75 m from the roof) consists almost completely of lime nodules located horizontally in general. Thickness 1.15 m

f) Clay, yellow-grey, greenish-yellow below, ferruginized, with a great number of limy nodules, sandy. On the contact with the abovelying sand there is a continuous layer consisting of marly nodules up to 0.10-0.15 m thick. Thickness 1.2 m

Erosion

5. a) Sand, grey, almost white, fine-grained, quartzy, slightly micaceous. Visible thickness 1.5 m

Above there occurs a series of young cover loams.

B. The section is in the main ravine where the deposits of the lower part of layer 5a inclusive are similar to those described above.

6. a) Clay, greenish-grey with red-brown and red spots of ferruginization. Flat lamination is vague. In the upper 0.40 m the clay is strongly sandy. Some layers of marly nodules spread along the bedding can be traced. Thickness 3.0 m.

7. a) Sand, fine- and medium-grained, with a mass of

marly nodules and roll muds.

Thickness 0.2 m

b) Sand, grey, fine-grained, quartzy, uniform, forming a crumbling slope. Higher, in a steep wall, on can see well that the sand has fine flat lamination with an interbed consisting of up to one meter of lump-shaped sandy nodules (cementation of the same sand). Thickness 5.5 m

c) Clay, green, sandy, lumpy, with marly nodules. Thickness 0.3-0.5 m.

The layer is strongly washed out, being in places completely absent.

8. a) The horizon of erosion consisting of roll muds and small marly nodules.

Thickness 0.25 m.

b) Sand, light-grey, medium- and coarse-grained, oblique-laminated with small gravel and marly nodules; alternates with medium-grained, locally ferruginized quartzy sand.

Thickness 2.0-2,5 m

Erosion

a) Horizon of erosion similar to layer 7a.

Thickness 0.35 m

b) Sand, light-grey, almost white, fine-grained, quartzy, slightly micaceous, flat-laminated.

Thickness 1.5 m

c) Sand, light-grey, fine-grained, flat-laminated, quartzy, slightly micaceous, calcareous.

Thickness 1.0-1.2 m.

d) Clay, green-grey with a large number of calcareous-marly nodules. Thickness 0.6 m

Erosion

9. Sand, light-grey and yellowish-grey, gently-oblique laminated, fine-grained.

Thickness 3.0 m.

The sands of layer 9 terminate the Lower Poratian deposits. These are cut by the alluvium of the Prut terrace VII.

10. Gravel, consisting predominantly of large Carpathian pebble and a great amount of marly rolls with lenticular interbeds of bluish-grey quartzy fine-grained sand with ferruginated bands. Thickness 2.0 m.

11. Sand, greyish-yellowish, fine- and medium-grained with clay interbeds up to 0.2 m thick with pebbles. Thickness 2.0 m.

Overlain by sandy loam, pink-pale-yellow, thin, light, dusty, evidently cover,

Visible thickness 1.2 m.

C. On the opposite slope of the ravine well exposed are alluvial and lagoon deposits of terrace VII. Here, on the Lower Poratian light-grey, almost white, fine-grained quartzy, well-washed sands with abrupt washout there occurs a basal horizon of terrace VII.

10. Gravel, consisting of Carpathian pebble with a great amount of large and small rounded marly nodules and roll muds with lenses of fine-grained, thin flat-laminated sand.

Thickness 2.0 m

11. Sand, loose, yellowish-grey, fine- and medium-grained, predominantly quartzy, uniform, flat-laminated, ferruginated in places.

Thickness 1.5 m

Higher there occurs a bed of lagoon deposits of the same age.

12. Sand, greenish-grey, thin flat-laminated with clay interbeds (banded lamination) that are ferruginated along the bedding.

Thickness 0.7 m.

13. Clay, grey, sandy, compact; when dried, is transformed into sharply angular rock debris.

Thickness 0.06 m.

14. Alternation of silt with fine-grained sand and clays. In silty interbeds there are thin lump-shaped sandy nodules up to 0.5 m thick. The layer of lagoon deposits is determined by laminated pale-yellow-pink and reddish silt.

Thickness 10.0 m.

15. Sandy loam, pale-yellow, thin, dusty, covering.

Thickness 15.0 m.

In the next ravine, in the lower part of the sandy-pebbled strata of terrace VII was found the fresh-water mollusk fauna: Viviparus romaloi Cob., V. pseudoachachatinoide Pavl., V.kagarliticus Lung., V. aff. tiraspolitanus Pavl. , Fagotia esperoides Sabba, Valvata naticina Menke, V.piscinalis Müll., Lithoglyphus acutus Cob., Theodoxus danubialis C.Pf. Bithynia vucotinovici Brus., Coretus corneus L., Planorbis L., Galba palustris Müll; Sphaerium rivicola Leach., Pisidium amnicum Müll., as well as that of brackish-water mollusks - Dreissensia polymorpha Pallas, Pachydacna sp., and terrestrial mollusks - Helicella sp. (Konstantinova, Chepalyga, 1972).

Among fresh-water mollusks predominant are recent species, but there can be observed fossil forms known from Upper Pliocene (Eopleistocene) deposits: Fagotia esperoides Sabba, Lithoglyphus acutus Cob., Bithynia vucotinovici Brus. A more exact age provide Viviparus romaloi Cob., V. aff. tiraspolitanus Pavl. peculiar to the deposits of

terraces VII and VIII of the Dniester and Danube rivers are correlated by us to the Apsheronian (Upper Eopleistocene).

An almost similar complex of fresh-water mollusks has been known from terrace VII deposits on the Khadjibey Liman near the village of Morozovka (not far from Odessa). In this place there can be also found Pachydacna kujalnicensis. This enables us to consider the Valeny terrace as the VII-th and attribute its deposits to the end of the Apsheronian (the end of the Upper Eopleistocene).

Fragments of mammal bones, mails and pieces of ostrich egg-shells can be observed in more coarse-grained alluvial deposits of this terrace. Here we found remains of Mastodontoidea gen.?, Archidiskodon cf. meridionalis Nesti, Bovinae gen.?, Equus cf. süssenbornensis Wüst, Equus sp., Asinus sp., Cervus sp., Cervidae gen.?(definitions by V.I. Gromov and L.I. Alexejeva),Ochotonidae gen,? Castoridae gen.? (definition by I.M. Gromov), fragments of egg-shells Struthio sp.,birds' bones and fragments of Testudo sp. All these confirm the Upper Eopleistocene age of the deposits.

On the Dniester and Prut rivers the deposits of the VII-th terraces are usually reversely magnetized and belong to the paleomagnetic epoch Matuyama. Lagoon deposits of the Danube terrace VII near the village of Valeny have normal magnetization. This can be explained by two ways: this is either the primary magnetization, or secondary one that is a result of remagnetization of rocks by a recent magnetic field. If this magnetization is primary, it could have been formed during one of the events of polarity of the Matuyama epoch (may be the normal Djaramillo event).

From **Valeny** the participants of the Colloquium come back to the town of Kagul and stay there over the night.

Friday, 26 May, 1972

Route: K a g u l - E t u l i a - N a g o r n o e

Excursion begins from the village of Vulkaneshty and follows south-westwards along the road of the previous route.

At the southern margin of the village of Etulia, near the mouth part of one of the deepest ravines there are exposed Pontian deposits. These are overlain by cyclic alluvial deposits of "Moldavian Russilion". The strata is overlapped by alluvium of the high (IX) terrace of the Prut with the fauna of the Khaprovian complex of the lowermost Upper Pliocene-Lower Eopleistocene. The alluvium of terrace IX is overlapped by a series of cover deposits with a number of horizons of buried soils and separating them deluvial loams.

Locality 2: Section near the village of E t u l i a ("Moldavian Russilion", alluvium of the Prut terrace IX, cover deposits)

The outcrop is situated at the southern margin of the village of Etulia. The summarized section is presented in Fig.4.

A. In the section of the left bord in the lower part of the ravine the Pontian deposits are exposed (from below upwards):

1. Silt, grey, spotty, with ferruginous spots, rather compact, thin-laminated.

Visible thickness 2.2 m.

The boundary with overlying deposits of layer 2 is not distinct.

2. Clayey silt, greenish-grey, compact, with small ferruginous nodules surrounded by frosty ferruginous spots. Thickness 1.0 m

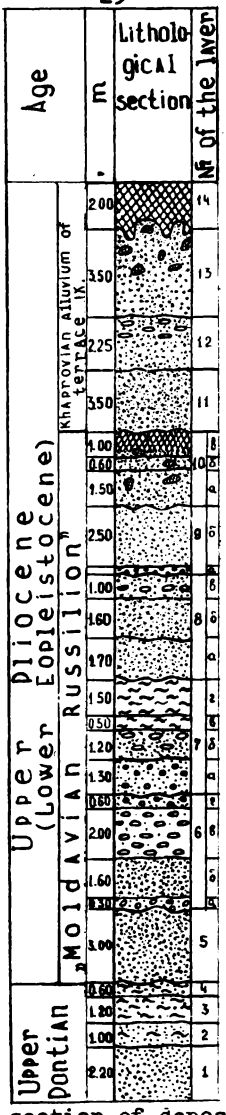


Fig. 4.Summarized section of deposits of "Moldavian Russilion" and alluvium of the Prut terrace IX near the village of Etulia.

3. Clay, black, compact, lumpy, with gliding planes.
Thickness 1.2 m.
4. Clayey silt, greenish-grey with frosty spots, compact. Thickness 0.5-0.6 m.
Alluvial deposits of "Moldavian Russilion" rest on the erosional surface of the Pontian.
5. Sand, grey, fine-grained, uniform, heavily quartzy, fine-laminated, water-bearing.
Thickness 1.4 m.
At a depth of 0.5 m from the surface there is a lense of the same sand with a mass of roll muds from Pontian clays, limestone pebble, black ferruginous manganese nodules and shells of unionides: Margaritifera aff. flabellata (Goldf.), Potomida pannonica (Neum,), P. saratae (Teiss.), P. bogatschevi (Gr.-Ber.). The shells are relatively small without any specific Levantinian features. The fauna is transitional from the Pontian to the Levantinian. Pontian and Dakian forms are: Margaritifera aff. flabellata and Potomida saratae (definition by A.L Chepalyga).
In one of the ravines, in its lower part, V.G. Botkina (Leningrad State University) managed to find in pale-yellow - grey sands of Moldavian Russilion, above greenish-black Pontian silt, shells of Potomida stolizkai Neum. and P. sibinensis (Pen.) (defined by A.L Chepalyga) - typical representatives of the Lower Poratian mollusk fauna.

B. In the right flange of the same ravine, somewhat higher than locality A., on Pontian grey-green silt there rests a cyclic alluvial strata of "Moldavian Russilion" (lowermost Upper Pliocene or Lower Eo-

pleistocene). Five alluvial members can be traced here, cutting one another (from below upwards):

5. Sand, light-grey, almost white, partially ferruginized, quartzy, fine-grained, gentle-oblique laminated; lenticular interbeds can be observed enriched with gravel and small pebble from lime-marly nodules and roll muds of grey-green Pontian clays.
Thickness 2.5-3.0 m

6. a) Sand, light-grey, medium-grained, quartzy with abundance of roll muds (horizon of erosion).
Thickness 0.2-0.3 m.

b) Sand, light-grey, quartzy, slightly micaceous, fine-grained with oblique and lenticular lamination of current ripples, with lenticular gritstone interbeds; the sand is locally intensely ferruginated. Some layers are folded. They are peculiar to the second horizon. Thickness 1.6 m.

c) Sand, yellow-grey, spotty-ferruginized, fine-grained, flat-laminated with six interbeds of platy sandstones up to 12 cm thick. They occur along the lamination. Thickness 2.0 m.

d) Sand, greyish-yellow, fine-grained, clayey with abundance of lime nodules uo to 5-6 cm in cross-section. Thickness 0.6 m

Erosion.

7. a) Sand, greyish-yellow, almost white, quartzy, slightly micaceous, oblique- and diagonal-laminated, with lenticular gritstony interbeds; gravel is the same as in layer 2a.
Thickness 1.3 m.

b) Sand, the same as in layer 3a, somewhat compact, flat-laminated; horizons of platy sandstones can be

observed along the bedding.

Thickness 1.2 m

c) Clay, greenisg-grey, sandy with ferruginous spot marly nodules occurring as horizontal interbeds.

Thickness 0.5 m.

d) Clay, greenish-brown, compact, coarse-lumpy with marly nodules. Thickness 1.5 m.

Erosion

8. a) Sand, light-yellow, fine-grained, somewhat ferruginized, quartzy, slightly micaceous with thin gravelly oblique- and diagonal-laminated interbeds.

Thickness 1.6-1.7 m

b) Sand, light-grey, fine-grained, quartzy, slightly micaceous, laminated, with horizons of platy sandstones up to 6-7 mm thick, arranged along the bedding. Thickness 1.6 m.

c) Sand, light-grey, fine-grained, somewhat compact, with sandy nodules arranged along the flat bedding too. Thickness 1.0 m.

Erosion

a) Gritstone, consists of marly nodules and roll muds, sometimes strongly manganous, cemented locally into conglomerate (horizon of erosion).

Thickness 0.15-0.2 m.

b) Sand, light-grey, medium-grained, quartzy, slightly micaceous, oblique-laminated. In its part the sand is saturated with lime (washing out of lime from recent soil).

Thickness 2.0-2.5 m

The sand is cut by the recent surface of the slope, the recent soil being developed on it.

50 m higher along the ravine, on its right flange there are well seen all above five alluvial members, plus one more member, the sixth. Between these two localities, in the small ravine side on the right slope one can see reddish-brown loams enclosed into the strata of "Moldavian Russilion", with humus alluviations in the upper part originating at the rewashing red fossil soils and cover loams separating them; these are young ravine deposits.

Further up the ravine on its both slopes the alluvial deposits of "Moldavian Russilion" can be traced. Near by, in the strata of light-grey sands of "Moldavian Russilion, at a depth of 2.5-3.0 m below the basal horizon of terrace IX, mammal remains have been collected: Anancus (?) sp., Dicerorhinus sp., Equus sp., Gulo sp., Cervus (Rusa) moldavicus Janov., Paracamelus alexejevi Hav., Cervidae gen.? (defined by L.I. Alexejeva), Vulpes odessanus Odintzov (defined by I.A. Odintzov), as well as ostrich egg-shells and mail fragments (Konstantinova, 1965, 1967).

In the ravines of Etulia the students of Leningrad State University under the guidance of L.I. Khozatsky collected a rich collection of remains of small and large mammals, reptiles, fish, etc. Among amphibians were found predominantly Rana and Bufo, as well as representatives of Colubridae family, genus Lacerta; remains of Ophisaurus panmonicus Korm. and Varanus sp. were found too.

Turtles are presented by remains of Testudo černovi nos., Testudo cucurganica Khos., Clemmys riabinini Khos. Clemmys pidopličkoi Khos., Emys orbicularis antiqua Khos. Birds are presented by remains of Grizaya odessana Zub., the latter being described by V.I. Zubareva (1939) from deposits of Odessa catacombs.

C. On the right and left walls of the given ravine, 200 m higher, along the bottom one can see fossil soil (illuvial horizon) crowning the alluvial strata of "Moldavian Russilion". The soil is red-brown with a great amount of limy nodules. Higher, with deep washout there occurs the alluvium of the Prut terrace IX with the fauna of the Khaprovian complex. The approximate thickness of alluvial deposits of the terrace in this place is 5-6 m. On them is developed lower red soil of the cover (section of the terrace alluvium will be described below).

Still higher up the ravine there is a rock scarp specified by presence of hard limy horizons in the alluvial member of "Moldavian Russilion" that are related to the fossil soil.

D. Above the rock scarp is exposed the upper part of "Moldavian Russilion" with developed fossil soil overlapped by the alluvium of the Prut high terrace that is crowned by thick strata of cover deposits. The following section can be observed here (from below upwards):

10. a) Sand, light-grey, fine-grained, slightly micaceous, flat-laminated, compact, carbonated, with red and red-brown ferruginous and black manganous spots and sporadic carbonate nodules.

Visible thickness 1.25-1.5 m.

b) The same sand, but with a great amount of bright brick-red spots with separate lime nodules they are separated from layer 1 by a horizon of large (up to 0.10-0.15 m in a cross-section) lime nodules (illuvial carbonate horizon of fossil soil). Thickness 0.6 m.

c) Sand, grey-greenish with brick-red spots, clayey, strongly compact, overfilled with large (up

to 0.10-0.15 m. in a cross-section) lime nodules that form a continuous calcareous layer (the same carbonate illuvium). Thickness 1.0 m.

Layers 1-3 are in the upper part of the strata "Moldavian Russilion".

On the erosional surface of layer 3 there rest alluvial deposits of the Prut terrace with the Khaprovian fauna of mammals. There is no channel facies in this section, whereas it can be seen in other sections; to this facies are related findings of mammal bones: Anancus arvernansis Cr. et Job., Archidiskodon cf. meridionalis Nesti, Dicerorhinus sp., Cervidae gen.? (defined by L.I. Alexeeva), Dolomys milleri Kormos, Pliomys kowalskii Schev., P. hungaricus, Mimomys ex gr. stehlini Kormos, M. praechungaricus Schevschenco, M. (Villania) sp., M. reidi Hinton (definitions by I.M. Gromov, L.P. Alexandrova) (Konstantinova, 1965, 1967).

The following section of the terrace is given (from below upwards):

11. Sand, pale-yellow, fine-grained, considerably quartzy, uniform, flat-laminated.
Thickness 3.5 m.

12. Sand, grey-greenish, fine-grained, somewhat more clayey with three horizons of small lime nodules which begin to appear at the height of 1.40 m over the layer base. From this very height there begin red-brown and reddish ferruginous spots.
Thickness 2.25 m.

13. The same sand, fine-grained with abundant red-brown spots and lime nodules with red mole-hills; in the upper part it becomes red-coloured (illuvial carbonate horizon of fossil soil.
Thickness 3.5 m.

14. Clay, red-brown, compact (illuvial clayey horizon of fossil soil). Thickness 2.0 m.

E. In the left flange of the same ravine is described the strata of cover deposits crowning the alluvium of the Prut terrace IX (Fig.5).

The section begins with the uppermost parts of the alluvial strata from below upwards:

1. Sand, snuff-coloured, fine-grained; consists of angular-rounded grains of quartz; feldspars, micas, chlorite, glauconite, etc. are in subordinate quantities. Cement is clayey, filmy, or of the type of filling the pores of complex composition with prevalence of hydromicaceous-montmorillonitic component with an admixture of chlorite-vermiculite and hydromica.

   Visible thickness 1.5 m.

2. Sand, snuff-coloured with sporadic red spots below, and mostly of red colour in the upper part of the layer. Being highly calcareous, it is characterized by phytogenous porosity. Sands gradually pass into red sandy clays of layer 3.

   Thickness 2.5 m.

3. Clay, red-brown, compact, sandy with sporadic subvertically oriented lime nodules. Here predominant are a mixed-layered hydromicaceous-montmorillonitic component and hydromica with a kaolinitic admixture. The lower boundary is very uneven. Thickness 0.8-1.1 m.

4. Loam, red-brown with a rare net of subvertically oriented lime nodules. At the base there are distinct traces of erosion in the form of a horizon enriched with small clayey and carbonate pebbles

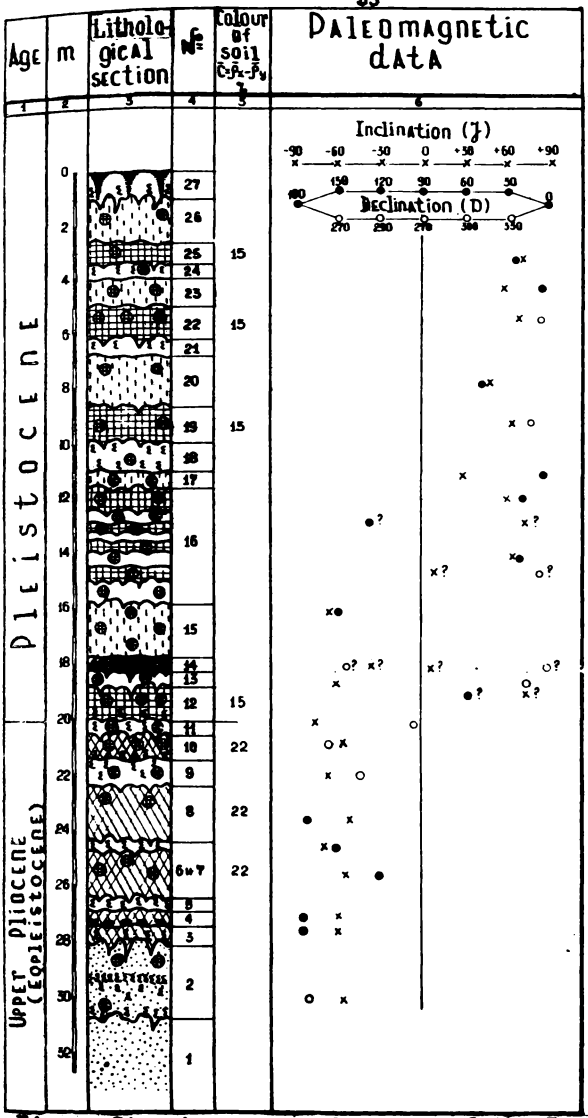


Fig.5. Structure cover deposits of the Prut terrace IX near Etulia

cement is clayey. From this layer begins the strata of cover deluvial deposits.

Thickness 0.5 m

5. Loam, red-brown, with whitish spots similar to a terrigene and clayey component of layer 4. It is cemented by clayey carbonaceous or carbonaceous cement and characterized by clearly expressed phytogenic porosity. The lower and upper boundaries are uneven.

Thickness 0.5 m

6. Clay, red-brown with black manganese gouges having prismatic jointing. When going up the section, the clay gradually becomes brownish.

Thickness 1.5-1.7 m.

All the layers described above are contiguous and partially superposing one another fossil soils (horizons of the clayey carbonate illuvium), the lower of which (layer 3) has been formed on the alluvium, whereas the two upper (layers 4 and 6) - on the cover deluvial deposits. Their formation is of the same geological age. They can be considered as a single soil zone that is synchronous to the alluvium of the Prut terrace VIII (the upper stage of the Upper Pliocene-Upper Eopleistocene).

7. Loam, clarified, clayey-carbonaceous, with molehills and phytogenic porosity. It differs from the underlying layer in sharply increased calcification. In the composition of the cement clay matter prevail the components that are present in illuvial horizons of fossil soils. However, here appear once again traces of inherited chlorite. The lower boundary is very gradual.

Thickness 0.3-0.7 m.

Clay, red-brown, sandy, with sporadic lime nodules and manganous dendrites. Upwards the section the rock becomes more loose, the colours gradually become lighter due to an increase of the amount of dispersed carbonate matter. Here becomes well pronounced phytogenic porosity, and the mole-hills are filled with greenish-grey loam (reverse mole-hills). In the sandy-aleuritic component predominant are angular-rounded quartzy grains with a significant admixture of muscovite. Feldspars, biotite, chlorite and glauconite are in rather subordinate quantities.

Fine-micaceous clay matter of the main mass coloured by ferrum hydroxides has been formed mostly of hydromicaceous-montmorillonitic component with an admixture of hydromica and chlorite. Thickness 2-2.2 m

From here on and higher, up to recent soil, the composition of a clay component of layers of various origin remains practically unaltered. The upper boundary is obscure.

Loam, greenish-grey, with clearly pronounced phytogenic porosity and numerous direct and reverse reworked mole-hills. Many remains of calcareous algae; in the upper part of the layer there appear small lime nodules ("beloglazka").

Thickness 1-1.1 m.

Loam, red-brown with manganous-ferruginized inclinations and films on the planes of prismatic jointing; in the lower parts it is essentially carbonaceous. Mole-hills can be found. The upper boundary is gradual.

Thickness 0.8 m.

Layers 8 and 10 are one more series of fossil soi corresponding to formation of the alluvium of the Prut ter race VII (upper stage of the Upper Pliocene-uppermost Upper Eopleistocene).

11. Loam, browny-green, clayey-carbonaceous with numerous traces of soricids, phytogenic porosity, calcareous algae and humus spots, their number increasing near the contact with layer 12.
Thickness 0.5-0.6 m.

12. Loam, brown, compact, carbonaceous with humus and manganese films on the planes of prismatic jointing. Colour intensity and rock density gradually decrease upward the section; at the same time there appear traces of soricids and phytogenic porosity. The upper boundary is gradual, very uneven. Thickness 1.2-1.3 m.

13. Loam, greenish-pale yellow, loess-shaped, porous with mole-hills, partly reworked by soil processes. The upper boundary is uneven.
Thickness 0.5 m

14. Loam, dark-grey, humus-coloured.
Thickness 0.5 m

15. Loam, greenish-pale yellow, loess-shaped with phytogenic pores and numerous traces of soricids (direct and reverse mole-hills). Abundant are remains of calcareous algae.
Thickness 2.0 m.

E. Continuation of the section can be well traced in the outcrop of the near-by ravine in which the same and higher horizons can be seen.

16. Loam, pale-yellow- grey, loess-shaped, porous, with traces of plant roots alternating with hori-

zons of brown fossil soils. There are four such horizons of fossil soils. They are divided by four horizons of clarified loess-shaped loams.

Thickness 3.4 m.

Layers 12-16 are complicated series of deluvial deposits, soils and soil ephemers corresponding to formation of the alluvium of the Prut terrace VI (lowermost Lower Pleistocene).

17. Loam, greenish-pale yellow, loess-shaped with phytogenic porosity and nereites filled with humus and manganese oxides, with mole-hills filled with material of overlying fossil soil.

Thickness 0.5-0,7 m

18. The same loam, greenish-pale yellow, loess-shaped, porous with a great amount of lime nodules, especially in the upper part; mole-hills are filled with humus. Thickness 0.8-1.0 m.

19. Loam, brown, compact, less porous than the underlying, has traces of plant roots, nereites and films of manganese oxides along the planes of jointing. Thickness 1.1-1.? m.

20. Loam, greenish-pale yellow, loess-shaped, porous with traces of plant roots and nereites, in the upper part there are mole-hills filled with material of abovelying soil.

Thickness 2.0 m.

21. The same loam, but with a great amount of lime nodules, and mole-hills filled with material of overlying fossil soil.

Thickness 0.8 m

22. Loam, brown, compact, unevenly coloured, somewhat less porous than the underlying loams, with mole-hills filled with overlying loess-shaped

loam. Thickness 1.0-1.2 m

23. Loam, greenish pale yellow, loess-shaped, porous, the pores being filled with humus.
Thickness 0.6-0.9 m.

24. The same loam, loess-shaped, but with small lime nodules and mole-hills filled with overlying red-brown loam.
Thickness 0.6 m.

25. Loam, intense brown, compact, porous (but less porous than underlying loam). The pores are filled with humus; reverse more-hills can be seen.
Thickness 0.6 m

26. Loam, pale-yellow, loess-shaped, porous with remains of plant roots and nereites,
Thickness 1.0-1.2 m.

Layers 17-26 are a series of deluvial deposits with three horizons of fossil soils of brown colour (layers 19,22 and 25). They correspond to time of formation of the alluvium of the Prut terraces V and IV (Lower Pleistocene and Middle Pleistocene).

27. Loam, brownish-carbonate-humic illuvial horizon of recent soil.
Thickness 1.0 m.

28. Recent soil - humic horizon.
Thickness 0.4 m.

The figure characteristic of colouring the fossil soils obtained through an analysis of spectrograms of corresponding samples. The colour of the soil (colour index - C) was determined according to the formula :

$$C = \rho_x - \rho_y$$ (Chupakhina, 1970,

where ρ_x - the average reflection of a sample in a long-wave part of the spectrum (720-570 mμ), ρ_y - the avera-

ge reflectance of a sample in a short-wave part of the spectrum (570-420 mμ), in %.

As a result, it has been determined that red-brown soils (layers 3,4,6,8,10) having a colour index 22, correspond to the Upper Pliocene (Eopleistocene), whereas the brown coloured soils (layers 12,16,19,22,25), with a colour index 15 correspond to the Lower- and lowermost Middle Pleistocene.

Paleomagnetic study of cover deposits provided values of the natural remanent magnetization (In) that range from 2.7 x 10^{-6} CGS to 112 x 10^{-6} CGS before thermocleaning, and from 0.7 x 10^{-6} CGS to 15 x10^{-6} CGS after thermocleaning. For the predominant part of the samples the thermocleaning enabled to remove 83-97% of the initial In, and this value was 30-50% for the samples from layers 1, 10, 12. Uncertain values of magnetic inclination (D) and magnetic declination (J) (on graphs these values are presented by "?") have been obtained from those samples where the value In after thermocleaning made up 3-5% of the initial value of In. Scattering of the values D and J for these samples is due not to small values In remaining after thermocleaning (they are 10-15 times higher than the threshhold response of the design equal to 0.1 x 10^{-9} CGS), but to considerable magnetization of samples during thermocleaning.

Fig. 5 shows that the lower part of the section up to layer 12 has reversed magnetization, whereas the upper part of the section, beginning from layer 19, has normal magnetization; layers from 13 to 18 have the direction intermediate between normal and reversed magnetization. This magnetization appeared at the moment of inversion of magnetic field that is the boundary of paleomagnetic epochs Matuyama-Brunes, the age of which is about 700,000 years

(Cox, 1969). A similar zone of transition of geomagnetic field was detected by M.A. Pevzner in a marine section of the Mishov-Dag mountain (Azerbaijan SSR) on the boundary between Upper Apsheronian and Bakunian deposits.

The analysis of paleomagnetic data of section Etulia enables us to conclude that reversed magnetized layers from 1 to 12 had been formed during the existence of a geomagnetic field of reversed polarity of the Matuyama epoch, whereas the normally-magnetized layers from 19 to 26 - during the time of Brunes normal polarity.

Thus, the last inversion Brunes-Matuyama coincides with the Upper Pliocene (Eopleistocene) - Pleistocene boundary. Its age is determined about 700,000 years.

After examination of the section near the village of Etulia we go towards the village of Nagornoe.

Locality 3. Section near the village of N a g o r n o e
(alluvium of the Danube terrace V)

A. Section of a sandy quarry (from below upwards), (Fig.6).

1. Sand, greenish-grey, flat-laminated, fine-grained, slightly micaceous, essentially quartzy.
Visible thickness 0.50 m.

2. Sand, greenish-grey, with ochreous and manganous bands, quartzy, slightly micaceous, flat- and oblique-laminated with thin lenses of gravel and small pebble; plates of sandstones and gritstones can be observed too. Among gritstones there can be found mollusk shells and considerable numbers of shell detritus.
Thickness 0.50 m.

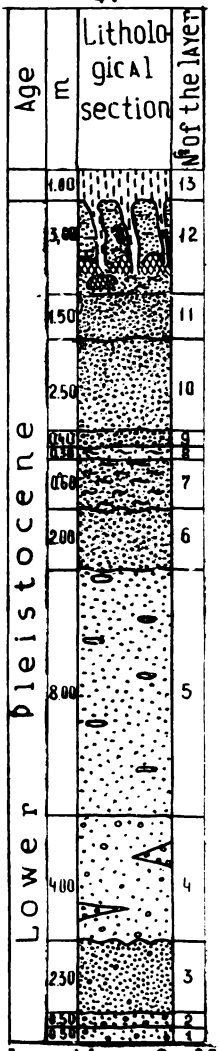


Fig. 6. Summarized section of alluvial deposits of the Danube river terrace V near the village of Magornoie.

3. Sand, greenish-grey with Liesegang rings, fine-grained, predominantly flat-laminated; one can observe oblique and diagonal lamination with gritstone interbeds.

In gritstone interbeds of layers 2 and 3 were found rodent teeth: Mimomys ex gr. intermedius Newton, M. sp.(containing little or no cement), Allophaiomys cf. pliocaenicus Korm., Lagurodon sp., Pitymys arvaloides Hinton, Microtus ex.gr. arvalis Pallas, Arvicola sp., Allactaga sp. (definition of I.M. Gromov and L.P. Alexandrova) and shells of fresh-water mollusks: Viviparus pseudoachatinoides Lung., V. pseudosadleri Pavl., V. istrienus Pavl., V.tiraspolitanus Pavl., V. conoid-angustus Pavl., V. kagarliticus Lung., V.diluvianus Kunth, Crassunio crassa Retz., C. sokolovi Bog., Anodonta sp., Theodoxus transversalis C.Pf. Fagotia esperi Fér., F. acicularis Fér., Lithoglyphus naticoides C.Pf. Valvata naticina Menke, V.piscinalis Müll., Dreissena polymorpha Pallas, Sphaerium rivicola Leach., Bithynia tentaculata L., Coretus corneus L. Planorbis sp., Helicidae (definition of G.I. Popov and A.L Chepalyga).

In the talus of layer 3 were found remains of Asinus sp. and Trogontherium cuvieri Fich. (definition of L.I. Alexeeva), as well as fragments of mails and fish remains: Silurus glanis L., Esox lucius L., Rutilus frisii (Nordm) (definition of E.K. Sychevskaya).

In sands there are also observed fragments of ferruginated decomposed wood and rather large nodules of buhrstones. Thickness 2.30 m.

Erosion

4. Gravel, coarse-grained, light-grey, quartzy, slightly micaceous with mollusk shells; contain plates of gritstones and buhrstones. Flat-, oblique- and cross-laminated. Thickness 4.00 m.

5. Sand, greenish, slightly ferruginated, fine- and medium-grained, predominantly flat- and oblique-laminated. Horizons and buhrstones and plates up to 1.0 m long are arranged along the beds in the sand strata. Thickness 8.0 m.

6. Sand, brownish-yellow, fine-grained. Thickness 2.00 m.

Above there occurs yellow-brown cover loam. Thickness 3.00 m.

B. The uppermost parts of the section of the Danube terrace V presented by lagoon deposits are exposed under the farm. Here, on the alluvial sands there rest lagoon deposits (from below upwards):

7. Sand, bluish-grey with ferruginated spots, micaceous, clayey, small and large, sandy calcareous nodules having up to 10 cm in a cross- section. In some places in the sand one can observe small plant detritus and humus spots. Thickness 1.60 m.

8. Clay, green-grey or yellow-grey with brown spots, sandy, lumpy, with marly nodules, occurring as a horizontal interbed. In this layer were found teeth of small mammals: Mimomys sp. (ex.gr. intermedius?), Allophaiomys cf. pliocaenicus Korm. (defined by I.M. Gromov). Thickness 0.35 m.

9. Sand, greenish-grey, quartzy, fine-grained, compact, overfilled with fresh-water mollusk shells.

Viviparus pseudosadleri Pavl., V. istrienus Pavl., V. tiraspolitanus Pavl., V. tortus Popov, Crassunio crassa (Retz.)., C. socolovi Bog., C.batavus Nilss., C. hassiae (Haas), Anodonta anatina L., Potomida litoralis (Cuv.), Unio pictorum L., Dreissena polymorpha Pallas, Theodoxus seratiliniformis Geyer, Th. transversalis C. Pf., Bythinia tentaculata (L.), B. leachi Shepp., Lithoglyphus naticoides C.Pf., Sphaerium solidum Norm., Valvata piscinalis Müll., V. pulchella Stüd., Pisidium amnicum Müll., Fagotia esperi Fér., Anisus spirorbis (L.), A. cf.vortex (L.) (definitions of G.I. Popov and A.L Chepalyga).

In the lower part there are numerous small lime nodules and shell detritus.

Thickness 0.40 m.

10. Sand, greenish-grey, fine-grained, sometimes dusty in interbeds. In the upper part the sand is compact almost up to siltstone. Ferruginated banding and ochreous spots around decomposed plant remains have been recorded too. Within thicker horizontal members there can be observed thin-laminated members containing ostracods: Cypria elongata Schneid., Cyprideis littoralis Br., Candoniella subellipsoida (Sharap.), Ilyocypris salebrosa Step., Candoniella albicans Br., etc. (G.F. Schneider).

Thickness 2.5 m.

11. The same greenish-grey sand with ferruginated manganous spots, fine-grained, considerably altered by soil processes (carboniferou illuvium of fossil soil). Thickness 1.50 m.

12. Sandy loam, compact, of a granular structure with phytogenic porosity, spots of an irregular

shape. In the lower part of the strata, on the 0.90-th m of the foot one can observe almost a continuous layer of clay with carbonate nodules. In places the clay is transformed into green-coloured gley (clayey carbonaceous illuvium of fossil soil). The layer is cut by vertical fissures along which the overlying loam is washed in.

Thickness 3.0 m.

13. Loam, yellow-brown, loess-shaped, porous, penetrated with plant roots, without visible lamination, altered by recent soil processes.

Thickness 1.00 m.

The above mollusk fauna both from the upper and lower parts of the sections of terrace V near the village of Nagornoe belongs to the Tiraspolian faunistic complex, and thus corresponds to the deposits of the V-th Kolkotovo terrace of the Dniester river. This fauna is peculiar to fresh-water facies of Upper Bakunian marine deposits. In addition to, the findings in the strata of lagoon deposits of brackish mollusk shells of Didacna cf. baeri-crassa Pavl., D. ex gr. tschaudae Andrus. and D. cf. pseudocrassa Pavl., together with shells of fresh-water mollusks enable a direct correlation of deposits of the given terrace with Baku-Chauda marine sediments.

Lagoon deposits of the Danube river terrace V near the village of Nagornoe have normal magnetization, as well as the alluvium of the Dniester terrace (Pevzner, Chepalyga, 1970).

Night in Kagul.

Saturday, 27 May, 1972

Route: K a g u l - C h i s h m i k i o i - D o l i n s k o e

Locality 4. Section near the village of Chishmikioi ("Moldavian Russilion", alluvium of the Prut terrace VIII

A. On the right margin of the right branch of the ravine in the central part of Chishmikioi village is exposed the strata of "Moldavian Russilion" (Fig.7).

1. Sand, light-grey, fine-grained, slightly micaceous, mostly quartzy, with irregular lenses of clay roll mud and rather large pieces of greenish-grey clays (up to 0.20 m in a cross-section). The whole strata consists of flat-laminated members within which one can well see oblique diagonal and gently-wavy lamination. In the lowermost parts of the strata there are interbeds of silting; in the upper part the bands are ferruginated.

Visible thickness 3.50-4.00 m.

Higher there is pale-yellow loam (young ravine alluvium. Thickness 1.00-1.50 m.

B. In the left bort of the same branch on the "Moldavian Russilion" strata having the visible thickness 4.50-5.00 m. there occur with wash out alluvial deposits of the Prut terrace VIII (upper stage of the Upper Pliocene - Upper Eopleistocene). The description is carried out from below upwards:

2. Sand, light-grey, coarse-grained, gravelly, oblique- and flat-laminated interbeds of gravel and conglomerate. Pebbles are small, Carpathian pebbles being observed too. In the lower part of the strata there are observed interbeds and len-

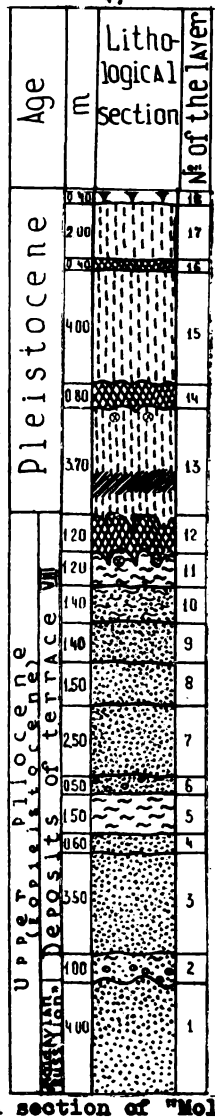


Fig. 7. Summarized section of "Moldavian Russilion" and the Prut river terrace VIII deposits near the village of Chishmikioi.

ses of light-yellow fine- and medium-grained sand and dark-grey sandy clays with plant reprints. In clays were found: Viviparus ex gr. pseudoachatinoides Pavl., Unio ex gr. pictorum (L), Fagotia esperoides Sabba, Valvata piscinalis Müll., Bythinia vucotinovici Brus., Litoglyphus acutus Brus., Dreissensia polymorpha Pall., etc.

Thickness 0.50-1.00 m.

In the layer are concentrated remains of large mammals: Anancus cf. arvernensis Cr. et Job., Equus cf. stenonis Cocchi, Capreolus (?) sp., Cervidae gen.?, Bovini gen?, Canis sp. (defined by L.I. Alexejeva), Archidiskodon meridionalis tamanensis Dubrovo (defined by I.A. Dubrovo and V.E. Garutt), Equus aff. süssenbornensis Wüst (definition of D.G. Kalke); small mammals are represented by Talpa sp., Desmana sp., Ochotonidae gen.? Castoridae gen? (large), Spalax cf.minor Topačevski, Cricetulus sp., Cricetus sp., Pliomys kowalskii Schev., P. episcopalis Mehely, P. krezoii Kowalski, Mimomys (Cseria) cf. gracilis (Kretzoi), M.(Cseria) konstantinovae Alexandrova, M. reidi Hinton, Villanyia sp., Ellobius sp. Lagurus (Lagurodon) arankae Kretzoi, Lagurini gen.? Allophaiomys cf. pliocaenicus Korm.(definitions of I.M. Gromov, L.P. Alexandrova, V.A. Topačevski , K.I. Shushpanov). In addition to, there were found fragments of egg-shells of Struthio sp., fragments of mails - Clemmys sp. (definition of L.I. Khozatsky).

In the list of rodents predominant are Lagurus (Lagurodon) arankae and Allophaiomys cf. pliocaenicus, that appear and florish in the Tamanian

faunistic complex only. The latter, together with findings of sporadic specimens Pliomys kowalskii, Mimomys (Cseria) cf. gracilis, M. (Cseria) konstantinovae, etc., peculiar to the deposits of an older age, may be accounted for by redeposition of these forms from the underlying strata "Moldavian Russilion".

3. Sand, greyish-yellowish, fine- and medium-grained, lenticularly laminated. Here can be found fragments of mammal bones, mails of Clemmys sp., and mollusk shells: twin valves of Unio chosaricus Bog., Viviparus neumayri-fuchsi Bog. nov. Brus. (defined by G.I. Popov). Thickness 3.0-3.50 m.

In the lowermost part of the layer 3 on the boundary with layer 2 was found a lower jaw with two teeth of Archidiskodon meridionalis tamanensis Dubrovo (definition of V.E. Garutt and I.A. Dubrovo).

4. Silt, dark-grey with ferruginated bands. Thickness 0.50-0.60 m.

5. Clay, dark-grey, lumpy, filled with small calcareous nodules. Thickness 1.00-1.50 m.

6. Sand, grey, coarse-grained with separate small pebbles, partly cemented by lime into conglomerates. Thickness 0.50 m.

In interbeds of coarse-grained sand were found remains of: Desmana sp., Erinaceidae (?), Lepus sp., Castoridae, Spalax cf. minor Topačevski, Cricetus cricetus subsp., Cricetus sp., Lagurus (Lagurodon), arankae Kretzoi, L. praepannonicus Topačevski, L. sp., Allophaniomys pliocaenicus Korm., Mimomys (Cseria) cf. gracilis Kretzoi, Allactaga sp. (defined by V.A. Topačevski and K.I. Shushpanov).

7. Sand, light, grey, locally yellowish, fine-grained, uniform, without pronounced lamination. Thickness 2.50 m.

8. Sand, brownish-grey, compact, in the upper part, at a depth of 0.5 m with ferruginated spots and abundant small (from 1-2 to 5 mm) ferruginous-manganese nodules of an irregular shape.

Thickness 1.00-1,50 m

Higher there rest cover loam, brown, porous, with small lime nodules altered by soil processes.

Visible thickness 1.50-3.00 m.

B. In the upper course of the ravine branch, under the asphaltic road passing from Chishmikioi to Etulia there are exposed the upper part of the alluvium of terrace VIII and the cover bed (from below upwards):

9. Silt, pinky-pale yellow, compact with ferruginous-manganese fluccans along vertical joint planes, porous, altered and compact by processes proceeding in soil, especially on the upper 0.5 m.

Visible thickness 1.40 m.

10. Loam, greenish-yellowish, sandy, lumpy with a mass of ferruginous-manganese fluccans, sporadic lime nodules; the loam is altered by soil processes. Thickness 1.40 m.

11. Clay, light-grey, sandy with lime crust along the fissures having the shape of vertical and horizontal plates. In the upper part - lime nodules and mole-hills filled with brown clay.

Thickness 1.20 m.

12. Clay, brown (fossil soil), compact, lumpy with manganese dendrites in spores, with lime nodules in the lower part of the layer.

Thickness 1.20 m.

D. In the left branch of the ravine is exposed the upper part of the cover strata which overlays the brown soil of layer 12. The surface of the soil is uneven;

13. Loam, pale-yellow, porous, loess-shaped with inverted mole-hills filled with brown loam of the underlying soil, with large calcareous nodules. In 1.00 m above the basement in loams there can be traced a humus inwash that is up to 0.50 m. thick.
Thickness 3.70 m

14. Loam, brown (fossil soil).
Thickness 0.80 m.

15. Loam, pale yellow, porous, loess-shaped, with lime nodules in the upper part. At the height of about 1 m from the bottom of the layer there is a humus inwash about 1 m. thick.
Thickness 3.50–4.0 m.

16. Loam, brown (fossil soil).
Thickness 0.40 m.

17. Loam, pale-yellow, loess-shaped.
Thickness 2.00 m.

18. Recent soil. Thickness 0.40 m.

Findings of Archidiskodon meridionalis tamanensis Dubrovo, Equus cf. stenonis Cocchi, Equus aff. süssenbornensis Wüst, prevalence of Microtinae subgenus Lagurodon and genus Allophaiomys, as well as mollusk shells peculiar to fresh-water facies of the Caspian Apsheronian, enable us to attribute the alluvial strata of the terrace of the Upper Pliocene upper stage (Upper Eopleistocene). The presence of remains of Lepus along with highly specialized Spalax minor Topačevski , and Cricetus cricetus, make this fauna similar according to V.A. Topachevsky's opinion (Khubka, Shushpanov, 1971), to the Nogaisk fauna assigned to the end of Late Pliocene (end of the Upper Eopleistocene).

The same seems to be confirmed by the data given below resulting from paleomagnetic measurements of the fossil soil developed on terrace deposits.

The paleomagnetic study of the section near the village of Chishmikioi enabled to establish that the values "In" of all the deposits, but layer 8, ranges within 3×10^{-6} CGS to 54×10^{-6} CGS before thermocleaning and from $0,3 \times 10^{-6}$ CGS to 10×10^{-6} CGS after thermocleaning. For all the samples, but one, 70-96% of the initial "In" were destroyed during thermocleaning, and only for a sample from layer 9 the value made up 50% of the initial "In". Just as for the Etulian section, the uncertain values D and J (with "?" in the figure) were obtained for the samples the value "In" for which after thermocleaning was below 5% of the initial "In".

The samples from the alluvial part of the sections layers 1,8,10) have reversed magnetization acquired during the existence of the geomagnetic field of reversed polarity of Matuyama epoch. The samples from the upper part of cover deposits (layers 15-17) had normal polarity (Brünes epoch). Magnetization of layers 11-14 has and intermediate direction, between normal and reversed. This magnetization might have been formed at the moment of geomagnetic field inversion that is the boundary of paleomagnetic epochs Matuyama-Brünes.

However, a figure characteristic of the colour of the lower fossil soil originated on the terrace alluvium, shows that this soil is attributed to red-brown (C=20.6), i.e. corresponds to the Upper Pliocene (Eopleistocene), concerning its age. In this relation the age of the alluvium of Chishmikioi terrace is given in the guide-book as the beginning of the Upper Eopleistocene, and the terrace is denoted as the VIII-th, though some authors (A.N. Khubka, K.I. Shushpanov) consider it somewhat younger - the VII-th

Prut terrace.

After examination of the section of terrace VIII in the village of Chishmikioi the participants of the Colloquium return to the Highway and go to the valley of the Danube river towards the town of Reni. At 3 kilometres' distance from Reni the buses turn round towards the village of Dolinskoe located on the left bank of the small river - Anadolka, near the Katsello liman.

Locality 5. Section near the village of D o l i n s k o e (Upper Poratian deposits, alluvium of the Danube terrace VIII)

Sandy-gravel quarries situated on the right bank of the Anadolka river expose deposits of the Danube river terrace VIII (Fig.8).

A. The exposure is located on the right bank of the Anadolka river against the village of Dolinskoe, to the left of the road leading from the village of Dolinskoe to the town of Reni.

In the channel of a small ravine there is exposed a contact of alluvial deposits of terrace VIII with Upper Poratian deposits forming the socle of the terrace (from below upwards):

1. Sand, grey, fine-grained, essentially quartzy, micaceous, oblique- diagonal- and cross-laminated. At a depth of 0.25 m from the layer surface there is a bank of the Upper Poratian mollusk fauna. These deposits can be traced downwards the ravine. Approximately at a depth of 1.5 m the floor of the first mollusks' bank, in the muddish interbed there was found the second bank. The fauna of the layer 1 from these two banks is presented by the following forms: Crassunio davilai (Por.), C.procumbens

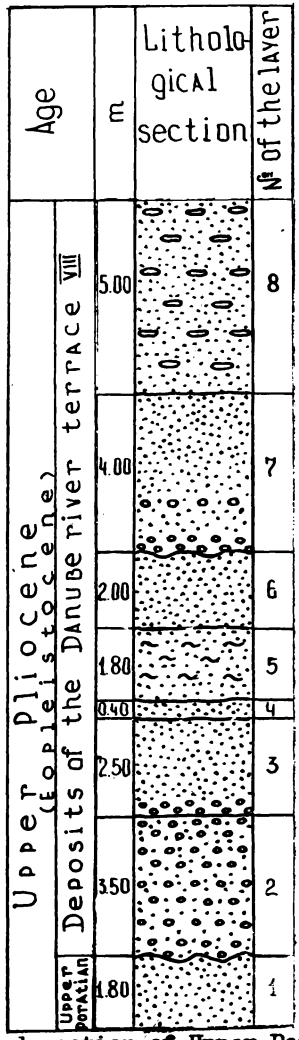


Fig. 8. Summarized section of Upper Poratian and the Danube river terrace VIII deposits near the village of Dolinskoie.

(Fuchs), Potomida munieri (Stef.), Ribia bielzi Czeck., Cuneopsidea doljensis (Stef.), C.excentrica (Pavl.), C.porumbarui (Tourn), Wenziella subclivosa (Teiss.), W. strossmayeriana (Por.), Viviparus bifarcinatus (Bielz), V.b.contigua Sabba, V. strossmayerianus (Brus.), V.proserpinae Bog., V.p. ecarinatus Pop., V.stefanescui Sabba., V.laskarevi Gr.-Ber., V.sinzovi Pavl., V. mammatus Sabba, V.craiovensis Por., Melanopsis (Melanopsis) rumana Tourn., M.(M.) pterochyla (Brus.), M.(Lyrcea) onusta (Stef,), M.(Lyrcea) slavonica (Neum.), Fagotia esperoides Sabba., Amphimelania fossariformis Tourn., Theodoxus slavonica Brus., Th.pilidei Tourn., Acella aquaria (Neum.), Lithoglyphus acutus Brus.

The next layer is a basal horizon of the alluvium of the Danube terrace VIII.

2. Conglomerate consisting of pebbles (usually small), sandstones, marls, limestones, jasper, acid igneous rocks (from Dobrudzha massif). Conglomerate is cemented by calcareous cement, contains abundant mollusk shells, broken and rounded, as a rule, being sometimes observed in twin valves too. The mollusks are partly redeposited from the underlying Upper Poratian deposits. Besides redeposited forms, there were found those peculiar to desalted Apsheronian facies, including valves of Bogatschevia sturi (Hörn.), etc., as well as bones of mammals. Conglomerate overhangs as a bench over Upper Poratian sands.

Visible thickness 0.50 m.

Nearby in the ravine, over the upper bank containing the Upper Poratian mollusk fauna, are traced laminated, compact silts up to 0.20 m thick, where, together with the mollusk fauna were found remains of small mammals: Erinaceidae gen., Dolomys milleri Nehr., Pliomys hungaricus Korm. Pliomys cf. hungaricus Korm., Pl.kowalskii Schev., Pl.lenkii Heller, Mimomys ex gr. stehlini Korm., Spalax sp., Apodemus sp. (defined by I.M. Gromov), i.e only old cementless forms of rooted voles peculiar to the fauna of the Khaprovian complex.

The mollusk fauna and remains of small mammals enable us to attribute Upper Poratian deposits to the uppermost Lower Akchagylian stage of the Upper Pliocene (uppermost Lower Eopleistocene).

B. Section of the quarry located at 150 meters' distance from the road leading from the village of Dolinskoe to the town of Reni (from below upwards).

2. Gravel, laminated, alternating with inequigranular sand and gravel. The bands are flat-bedded; the lamination within the bands is lenticular, oblique and diagonal. Sand and pebble are heavily ferruginized in places, manganous and cemented into conglomerates. In the upper part of the strata one can observe lenticular interbeds of compact, light-grey micaceous silt up to 0.4 m thick.

Visible thickness 3.50 m.

Gravel is a basal horizon of the alluvium of terrace VIII that rests with deep washout on the underlying socle formed by Upper Poratian deposits; they can be seen above the water line of the Katsello liman over 1.5-2.0 m. Remains of the rich fauna of large mammals have been collected in the basal gravel: Archidiskodon meridionalis

tamanensis Dobrovo (definition of V.E. Garrut and I.A. Lubrovo), Palaeoloxodon antiquus (?) Falc., (definition of V.E. Garutt), Equus sp. (similar to E.süssenbornensis,definition of G.D.Kahlke), Dinotherium sp. (probably redeposited) Dicerorhinus etruscus Falc., Elasmotherium cf. caucasicum Boriss., Bison suchovi Alexeeva, Eucladoceras cf. pliotarandoides Alex;, Eucladoceros sp., Paracamelus sp., Cervidae gen? (large form from Orthogonoceros group), Carnivora gen., Trogontherium cuvieri Fisch.(defined by L.I. Alexeeva). In addition to, here can be found fragments of egg-shells Struthio sp., and those of mail Clemmys sp. (definition of L.I. Khozatsky). In this very place, in the basal horizon were found mollusks peculiar to the VIII-th terraces of the Dniester, Prut and Danube: Bogatschevia sturi (Hörn.), B.scutum (Bog.), Crassunio cf. crassoides (Tshep.), Viviparus cf. böcki Hal., V. pseudoachatinoides Pavl., V. pseudoartesicus Lung., V.kagarliticus Lung., Fagotia esperoides (Sabba), F. acicularis (Fér.), Valvata naticina (Menke), Bythinia vucotinovici Brus.

There can be also met sculptured forms (frequently slightly rounded, redeposited from the strata of the underlying Upper Poratian socle.

3. Conglomerate, light-grey, fine-pebbled, strongly cemented, laminated; among pebbles are present crystalline rocks (materials from Dobrudzha massif). Thickness of the conglomerate plate is 0.3 m. Higher, there occur gravel of the same composition and light-grey, ferruginous and manganous fine-grained, oblique- and flat-laminated sand.

Thickness 2.0-2,50 m.

In layer 3 in a number of the nearest quarries there were collected remains of large and small mammals: Bison sp., Equus sp., Ochotonidae gen?, Castoridae gen? (large), Mimomys reidi Hint., Allo-

phaiomys cf. pliocaenicus Korm., Lagurini gen? Lagurini gen?, Microtinae gen.? (rootless and cementless; definition by I.M. Gromov, L.P. Alexandrova). In addition to, poorly preserved mollusk shells and shell detritus are observed throughout the strata.

4. Sand, light-grey, and yellowish-grey, inequigranular, micaceous, flat-laminetaed.
Thickness 0.34–0.40 m.

5. Sandy loam, yellow-grey, micaceous, thin-flat-laminated, ferruginated along the bedding, more thick-laminated in the upper part, with interbeds of grey, muddy clays.
Thickness 1.80 m.

6. Sand, snuff-coloured, more-yellow upwards, heavily micaceous, thin-flat-laminated.
Thickness 1.5–2.00 m.

Erosion

7. Sandy-gravel laminated strata; separated interbeds of gravel and sand reach the thickness of 0.3–0.4 m. Among pebbles there is abundant local material. Thickness 5.00 m.

8. Sand, yellow-grey with snuff-colour tint, micaceous, thin-grained, flat-laminated with interbeds of compact micaceous silt, with flat silt nodules of various shape arranged along the bedding (lagoon deposits). Visible thickness 4.5–5.0 m.

Findings of molars of Archidiskodon meridionalis tamanensis Dubrovo, Equus aff. süssenbornensis Wüst, voles Lagurodon and Allophaiomys, as well as Bogatschevia sturi (Hoërn), Viviparus tiraspolitanus Pavl., V.tiraspolitanus pseudoartesicus Lung. and V. cagarliticus Lung., reachin

according to G.I. Popov's opinion, their florish in the Apsheronian time, enable us to attribute alluvial deposits of terrace VIII near the village of Dolinskoe to the Upper (Apsheronian) stage of the Upper Pliocene (Upper Eopleistocene, its lower part, in particular).

The alluvial deposits of terrace VIII near the village of Dolinskoe have reserved magnetization and are, thus, assigned to paleomagnetic epoch Matuyama, this confirming their Eopleistocene age.

The fossil soil developed on the alluvium of the given terrace is of red-brown colour (C=21.6) and corresponds to the lower fossil soil in the section of the terrace near Chishmikioi. This allows to regard these two terraces as having the same age.

After the examination of the quarry near the village of Dolinskoe the participants return to Kagul and then to Kishinev.

Night in Kishinev.

EXCURSION IN EAST GEORGIA

The Colloquium is proceeding on the area of East Georgia where the participants will get acquainted with geology and fossil vertebrates in Kvabebi locality.

Tuesday, May 30, 1972

Route: Tbilisi - Quemo - Bodbe - Kvabebi - Signakhi

The excursion begins within the city of Tbilisi situated on the eastern subsidence of the Adjaro-Triolet folded system in the valley of the Kura river.

Tectonics of the eastern subsidence of the Adjaro-Triolet system in the Tbilisi region is characterized by development of rather gentle folding. Within the city of Tbilisi and adjacent regions where the route runs, volcanogenic- terrigene depcsits from the Middle Eocene till the Pliocene are exposed on the surface.

Middle Eocene volcanogenic-sedimentary formations are well exposed on the left bank of the Kura river near the Metekh cliff. In the upper part they are presented by blocky breccia known in literature under the name of "conglomerates of confused bedding".

Then the participants of the excursion, going to the Avchal hydropower station through Avlabar towards Kakhetinsky High-way, cross the eastern subsidences of the Mamadavitskaya and Norio-Patardzeulskaya anticlinal folds and dividing their Ormolanskaya syncline(Fig.9).

Having left the town, we are going towards the Samgorskoie plateau where on the eastern subsidence of the folds

Scheme
of the excursion routes in East Georgia and West Azerbaijan

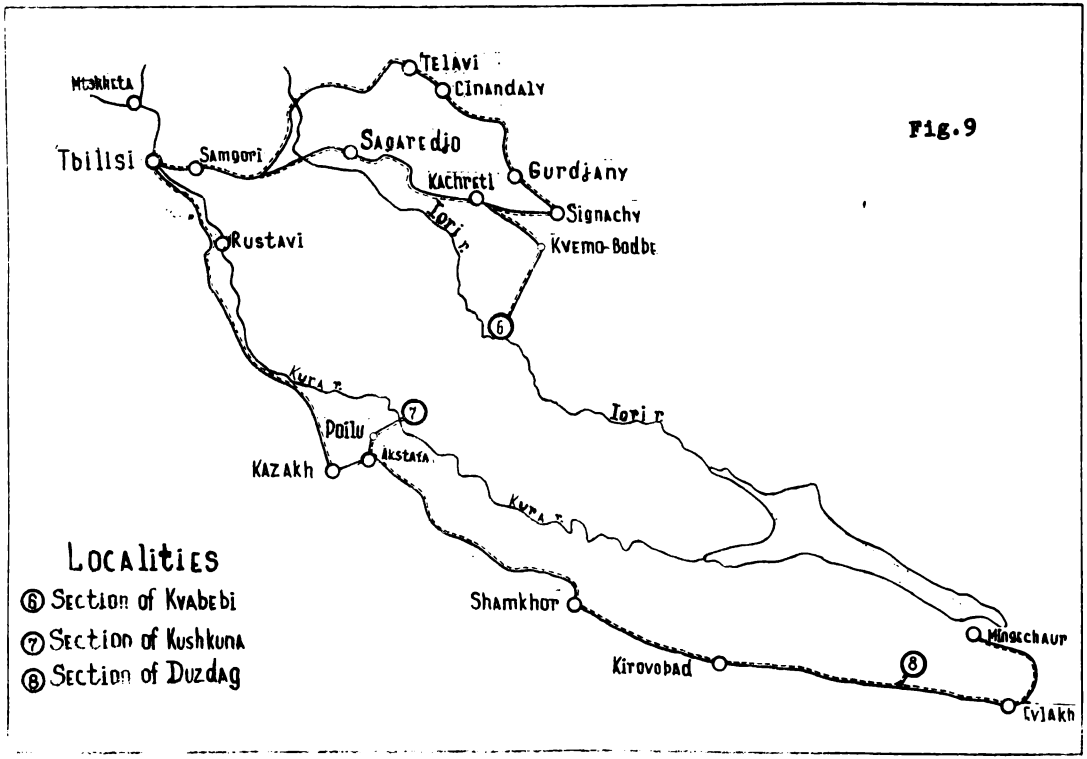


Fig.9

are developed Upper Eocene and Oligocene-Lower Miocene normal terrigene deposits.

Along the route the participants of the excursion may observe the outcrops of sandy clays of the Maikopian series, covering conformably similar Upper Eocene rocks. The Maikopian series embracing the Oligocene and Lower Miocene is presented by thin-laminated gypsiferous clays with large septarian nodules and jarositic illinitions. To the uppermost parts of the Maikopian series are associated thick strata (200 m) of coarse-grained quartzy sandstones (correlated to the Burdigalian) and thin-laminated book clays (400m) with interbeds of thin layers of loose yellowish sandstones (correlated to the Gelvetian).

Further, along the Kakhetinsky Highway, one can see isolated outcrops of Miocene deposits, and in the north - thick molassic conglomerate of Upper Sarmatian and Pliocene age forming dip cliffs and elevations on the southern slope of the Tsiv-Gomborsky range. Along the route these deposits are exposed near the town of Sagaredzho in the vicinity of Nino-Tsminda village where on an elevation there is a wonderful monument to the old Georgian architecture - Nino-Tsminda Temple (YI age).

Molassic Pliocene formations stretch along the route up to the village of Quemo-Bodbe located on continental conglomerate formations of the Upper Pliocene (Akchagilian-Apsheronian) of the northern flank of the Gare-Kakhetinskaya (Middle-Kurinskaya) depression.

The Gare-Kakhetinskaya depression is one of large tectonic units of a molassic zone of the eastern subsidence of the Georgian block and is attributed to the Bazaleti-Shirak subzone. It occupies almost the whole area of the Iory highland reaching 900-I,000 m high, and consists of

Pliocene molassic formations (denudation products of Cretaceous flysh deposits and Jurassic volcanogenic sedimentary rocks of the folded system of the Greater Caucasus southern slope). Older Neogene sediments, Sarmatian, in particular, are exposed here in the arched part of the anticlinal fold Mlashis-Khevi.

Going from the village of Quemo-Bodbe along an earthen road, we cross a wide and gentle syncline Vake composed completely of continental sandy-clayey and conglomerate formations of the Akchagylian mantle on a greater part of the Vake area by Quaternary deposits. Then, crossing a narrow Lambalo-Mlashis-Khevi anticlinal uplift, the route enters again a wide depression (Naomari syncline). It also consists almost completely of Pliocene molassic formations, differing, however, in the following: in the southern limb of the syncline begin to appear the marine fauna of the lowermost Akchagylian strata.

On the right limb of the Naomarian syncline one can observe near the Shwindkel pass good exposures of the lowermost parts of continental Akchagylian deposits. It overlies with slight disconformity the sandy-conglomerate deposits of the Shirak suite correlated to the Meotian-Pontian.

Crossing the southern limb of the Shindkelian anticline at the foot of the Kvabebi mountain, one can sea a tectonic contact of steeply dipping beds of the Shirakian suite with conglomerates of the upper Akchagylian of the northern limb of the Kvabebi syncline. Owing to this break, a considerable part of the steeply dipping northern limb of the Kvabebi syncline is overlapped by overthrusting deposits of the Shirakian suite of the southern limb of the Shwindkel anticline.

The Kvabebi syncline is situated between anticlinal

folds of Shwindkeli and Kila-Kupra. It is of an asymmetric structure with dip (80-90°) northern and gentle (15-25°) southern limbs. The route of the excursion runs near its eastern periclinal termination, this being well seen near the Kvabebi mountain.

The excursion stops at the junction of two ravines, Kvabebiskhevi and Mshrali-Khevi on the southern limb of the Kvabebi syncline where one can clearly see the transgressive occurence (with an abrupt angular unconformity) of basal Akchagylian conglomerates of the southern limb of the Quabebi syncline on sandy-clayey continental deposits of the Shirakian suite of the northern limb of the Kila-Kuprian anticline.

Locality 6. Section in the K v a b e b i area (Akchagylian deposits).

Here, the following alternation of layers can be observed (from below upwards).

1. Pebbled conglomerate; with sporadic (up to 10%) small boulders with well pronounced lamination. The boulders are well associated mostly to the lower part of coarse-pebbled interlayers. Scarce lenses of clays and clayey sandstones (up to 0.1-0.15m) may be observed. Conglomerate cement is loose. Thickness 15.30m
2. Aleuritic clays, grey, yellowish in places, with an admixture of sand and gravel, with lense-shaped interlayers of pebbled conglomerate and calciferous aleuritic clay with gypsum.
   Mollusks: Avimactra subcaspia Andrus., A.karabugasica Andrus., A.venjukovi Andrus., A.ossoskovi Andrus., Clessiniola utvensis Andrus., G.intermedia Andrus., Clessiniola., Helix aff. rosani Alz.

Ostracods: Cyprideis littoralis (Brady), C.punctillata (Brady), Loxoconcha eichwaldi Livent., Loxoconcha sp. Foraminifera: Ammonia beccarii (Linnè).

Thickness 2.90m.

3.Gap in the outcrop 1.50m.

4.Coquina: Avimactra schirvanica Andrus., A.imago Andrus., A. subcaspia Andrus., A. karabugasica Andrus., Clessiniola utvensis Andrus., C. intermedia Andrus., Ostracods: Cyprideis littoralis (Brady), C. punctillata (Brady), Loxoconcha eichwaldi Livent., Loxoconcha sp. Foraminifera: Ammonia beccarii (Linnè).

Thickness 0.80m.

5.Alternation of loose lumpy aleuritic clay and sandy alerolites. Mollusks: Avimactra karabugasica Andrus., A.venjukovi Andrus., A.schirvanica Andrus., A.inostranzevi utvensis Andrus., A. imago Andrus., A. miserabilis Andrus.,A. ossoskovi Andrus., Clessiniola utvensis Andrus., C. intermedia Andrus. Ostracods: Cyprideis littoralis (Brady), C. punctillata (Brady), Loxoconcha eichwaldi Livent., Foraminifera: Ammonia beccarii (Linnè).

Thickness 5.30m.

6.Aleuritic clay and sandy aleurolites, loose with numerous gypsum veins and rerruginized intercalations assigning a thin-laminated structure to a rock. Ostracods: Cyprideis littoralis (Brady), Loxoconcha eichwaldi Livent., Loxoconcha sp. Foraminifera: Ammonia beccarii (Linnè). Leaf reprints.

Thickness 2.90m.

7.Gap in the outcrop 2.10m.

8.Compact sandstone Thickness 0.80m.

9. Sandy clay with interlayers of yellowish-grey sandstones and rat dark grey and light grey clay. Ostracods: Ilyocypris gibba Ramd., Caspiolla sp., Cyprideis littoralis (Brady). Foraminifera: Ammonia beccarii (Linnè).

Thickness 8.00m

10. Sandstone loose, with an admixture of gravel and with an lense-shaped interlayer of fine pebble.

Thickness 5.00m

11. Clay compact, bluish-grey with charred plant remains. Mollusks: Avimactra sp., Helix sp. Ostracods: Candona sp., Cyprideis sp.

Thickness 1.60m

12. Clay bluish-grey with interlayers of loose sandstones with thin intercalations and sideritic veins.

Thickness 1.60m

13. Sandstone massive, loose, with one interlayer of bluish-grey clay.

Thickness 1.90m

14. Gap in outcrops 2.90m

15. Clay aleuritic, bluish-grey, with intercalations of gypsum and siderite. Mollusks: Avimactra subcaspia Andrus., Cardium dombra Andrus., C. aff. abreki Usp., C. vogdti Andrus., Cardium sp., Theodoxus sp., Clessiniola sp. Ostracods: Candoniella sp., Cyprideis littoralis (Brady). Foraminifera: Ammonia beccarii (Linnè).

Thickness 0.20m

16. Clay aleuritic with sideritic illinations and intercalations.

Thickness 8.80m

17. Clay bluish-grey, locally yellowish-red-brown,

with gypsum and sideritic intercalations. Mollusks: Avimactra subcaspia Andrus., A. karabugasica Andrus., Cardium vogdti Andrus., Cardium sp., Clessiniola intermedia Andrus., Clessiniola sp. Ostracods: Candoniella sp.,Cyprideis littoralis(Brady). Foraminifera: Ammonia beccarii (Linnè).

Thickness 3.20m

18. Alternation of bluish-grey calciferous clay and loose sandstone. Mollusks: Cardium sp., Unio naphtalanicum Alz., Clessiniola utvensis Andrus.;Ostracods: Eucypris sp.,Cyprideis littoralis (Brady); Foraminifers: Bolivina sp., Milliolina sp., Ammonia beccarii (Linnè). Thickness 2.00m

19. Sandstone loose, clayey, with veins of carbonate. Mollusks: Avimactra venjukovi Andrus., Cardium dombra Andrus., C. cucurtense Andrus., C. azerbaidjanicum Alz., Potamides sumbarensis Koles., P. eldaricus Koles., Clessiniola sp. Ostracods: Cyprideis littoralis (Brady), foraminifera: Ammonia beccarii (Linnè).

Thickness 3.00m

20. Clay bluish-grey with interlayers of loose clayey aleurolite and numerous thin sideritic intercalations. Foraminifera: Ammonia beccarii (Linnè).

Thickness 20.70m

21. Clay yellowish-red-brown with numerous thin intercalations of siderite with an interlayer of loose clayey aleurolite.

Thickness 14.30m

22. Gritstone coarse-grained, brownish, with inclusions of small pebbles, passing above into polimictic sandstone.

Thickness 2.00m

23. Clay, bluish-grey, sometimes containing sandy and aleuritic material and sideritic illinations and plates. Mollusks: Avimactra sp., Cardium ebersini Koles., C. naphtalanicum Alz., Cardium sp. Ostracods: Cyprideis littoralis (Brady). Foraminifera: Ammonia beccarii (Linnè).

Thickness 5.80m

24. Sandstone, finegrained, brownish-grey, loose, with numerous shell debris.

Thickness 0.60m

25. Clay, bluish-grey with interlayers of darker and yellowish clay with gypsum.

Thickness 6.60m

26. Clay, bluish-grey with thin (2-3cm) intercalations of loose sandstone with gypsum. Mollusks: Avimactra subcaspia Andrus., Cardium azerbaidjanicum Alz., Cardium sp., Clessiniola sp; Ostracods: Cyprideis littoralis (Brady), Leptocythere gubkini Livent., Loxoconcha laevatula Livent., L. petasa Livent. Foraminifera: Bolivina sp., Ammonia beccarii (Linnè).

Thickness 2.50m

27. Clay, bluish-grey with gypsum and sideritic intercalations.

Thickness 9.60m

28. Clay, banded, bluish-grey with an admixture of ash material, with one interlayer (up to 15 cm) of volcanic banded ash. Mollusks: Avimactra sp., Cardium dombra Andrus., C. azerbaidjanicus Alz., Ostracods: Cyprideis littoralis (Brady), Loxoconcha laevatula Livent., L. akschagilica Mandelst., Loxoconcha sp., Leptocythere gubkini Livent.

Thickness 6.60m

29. Clay bluish-grey with yellowish - brown clayey interlayers (in the roof - interlayers of whitish volcanic ash).

Thickness 15.00m

30. Gap in the outcrop.

Thickness 6.10m

31. Aleurolite clayey, thick-laminated, yellowish-grey.

Thickness 2.90m

These layers contain a rich fauna of vertebrates. Birds: Struthio transcaucasicus Burtsch. et Vek. Mammals: Canis sp., Nyctereutes megamastoides (Pomel), Ursus arvernensis Cr. et Job., Therailurus sp., Felis (Lynx) issidorensis Cr. et Job., Machairodus davitasvilii Vek., Hystrix cf. primigenia (Wagner), Anancus arvernensis (Cr. et Job.), Kvabebihyrax kacheticus Gab. et Vek., Hipparion crusafonti Vill., Dicerorhinus megarhinus (Christol), Propotamochoerus provincialis (Gerve), Eucladoceros sp., Pseudalces sp., Procapreolus sp., Parastrepsiceros sokolovi Vek., Ioribos aceros Vekua, Protoryx heinrichi Vekua, Oryx sp., Gazella postmitilinii Vek., Eosyncerus ivericus Vekua.

32. Clay brownish-grey, laminated.

Thickness 2.50m

33. Clayey sandstone, yellowish-grey, and brownish-grey clay with shell debris.

Thickness 2.80m

34. Clay aleuritic, yellowish-grey with one interlayer (0.6m) of yellowish coarse-grained sandstone with a rich fauna. Mollusks: Avimactra subcaspia Andrus., A.venjukovi Andrus., Avimactra sp., Car-

dium ebersini Koles., C.naphtalanicum Alz., Cardium sp., Potamides eldaricus Koles., Potamides sumbaricum Koles., ostracods: Candona aff. danatensis Roz., Cyprideis littoralis (Brady), C.punctillata (Brady), Loxoconcha kopetdagica Roz., L. laevatula Livent.

Thickness 6.20m

35. Clay bluish-grey, locally with an admixture of sandy material, with one interlayer (0.6m) of dark-grey sandstone in the upper part. Mollusks: Helix roseni Alz., Helix sp. Ostracods: Cyprides littoralis (Brady), C.punctillata (Brady). Foraminifera: Ammonia beccarii (Linnè).

Thickness 9.20m

36. Clay bluish-grey, laminated.

Thickness 1.000

37. Sandstone yellowish-grey, fine-grained, loose.

Thickness 2.20m

38. Clay aleurolitic, bluish-grey with numerous incrustations and plates of siderite. Mollusks: Helix sp., ostracods: Candona aff. danatensis Roz., C.sulacensis Mandelst., Cypria candonaeformis (Schw.), Zonocypris membranae(Livent.), Ilyocypris gibba(Ramd.).

Thickness 5.60m

39. Gritstone sandy, polimictic, compact, brownish-reddish with sideritic incrustations and inclusions of small pebbles (Quartzy pebbles prevailing).

Thickness 2.50m

40. Clay aleurolitic, bluish-grey, locally with an admixture of sandy material.

Thickness 2.00m

41. Gritstone compact, brownish with a lense of small-pebbled conglomerate.
Thickness 0.80m

42. Clay bluish-grey with an admixture of sandy and arenaceous-aleuritic material. Ostracods: Candona comptis Mark., Candoniella sp., Darwinula sp.
Thickness 4.60m

43. Sandstone gritstony, yellowish-grey.
Thickness 1.00m

44. Alternation of yellowish-grey clay with sideritic plates and yellowish-brown loose polimictic sandstone (0.6 - 0.8).
Thickness 9.70m

45. Clay yellowish-grey with lenses of yellowish loose sandstone.
Thickness 3.10m

46. Sandstone loose, locally clayey.
Thickness 4.80m

47. Clay aleuritic, brownish-grey.
Thickness 4.80m

48. Sandstone clayey, loose, with oblique lamination.
Thickness 2.40m

49. Gap in the outcrop.
Thickness 5.00m

50. Sandstone polimictic, yellowish-grey, compact, locally loose with abundant accumulations of fragible shells Unio cyrensis Alz.
Thickness 1.85m

51. Conglomerate small-pebbled with a lense of coarse-grained sandstone.
Thickness 1.30m

52. Clay bluish-grey with shells Unio sp.
Thickness 4.00m

53. Clay yellowish-grey with sideritic illinations.
Thickness 1.50m

54. Sandstone loose, fine-grained with sideritic illinations.
Thickness 1.20m

55. Sandstone clayey, loose.
Thickness 2.00m

56. Clay bluish-grey with sideritic plates.
Thickness 2.00m

57. Clay bluish-grey with interlayers of compact sandstone.
Thickness 5.00m

58. Sandstone loose, yellowish-grey with lense-shaped interlayers of coarse-grained sandstone with an admixture of gravel.
Thickness 3.20m

59. Conglomerate gritstony-small-pebbled with lenses of coarse-grained sandstone.
Thickness 2.10m

60. Sandstone polimictic, clayey, yellowish-brown-red.
Thickness 15.00m

61. Clay aleuritic with Cyprideis littoralis(Brady), Ammonia beccarii (L.).
Thickness 5.00m

62. Conglomerate and sandstone forming a high steep bench on the southern slope of the Kvabebi mountain. In the outcrop one can observe an alternation of thick beds (0.5 - 5.0m-) of pebbled conglomerate with an admixture of boulders and yellowish clayey sandstones with inclusions of pebbles.
Thickness 80.00m

Worth attention in the Kvabebi section is a regular distribution of lithological types of rocks as well as mollusk and ostracod faunas.

The lithological section is roughly subdivided into three parts. Clay formations with interlayers of aleurolites, and less frequently sandstones are predominant over the basal Akchagylian conglomerate up to layer 39. From layer 40 to layer 50 the importance of sandy formations sharply increases, and from layer 51 to the end of the section most importance become coarse rocks i.e. conglomerate with an admixture of small, and less frequently large boulders. Worth attention is that the conglomerates of the Akchagylian basement and its upper part are identical as to lithological composition of pebbles. Only a cerian difference can be recorded in a degree of cementing and sorting of the material.

A better pronounced regularity is observed in distribution of faunistic associations. First of all, worth attention is the stage development of the mollusk fauna. To the first stage (layers from 2 to 18) is attributed the formation of the main mollusk complexes of Early Akchagylian. The second stage (layers 19-35) are characterized by flourish of all the groups of Akchagylian mollusks, and the third (layers 36-62) - by impoverishment of the fauna, extinction of all principal complexes of sea mollusks and appearance of some fresh-water forms. Accordingly, three complexes of the mollusk fauna can be distinguished that differ clearly one form another in their specific composition. The first stage is characterized by abundance of Mactra-Clessiniola association. In the second half of this stage (layers 15-18) there appears an association of Cardidas.

The second stage (layers 19 - 35) is characterized by a vigorous development of both associations, to their specific and quantitative composition, and along with these, the Cerithidae groups.

In the third stage (layers 39-62) almost all the association groups become extinct (only sporadic representatives of Mactra remain preserved) and representatives of such frish-water forms as Unio and Helix spread rapidly. The similiar regularity can be observed in distribution of the ostracod fauna. Layers 4-18 are characterized by associations of ostracods Cyprideis littoralis and foraminifera Ammonia beccarii. Above (layers 19-37), the same complex of ostracods remains preserved, but as to their quantity, it is considerably poorer. Worth attention is that in the given interval of the section, as it has been already mentioned, a complete flourish of the mollusk fauna can be observed.

Layers 38-62 are characterized by another complex of the Ostracoda fauna consisting predominantly of fresh-water forms Candona; along with the letter are also found representatives of fresh-water Darvinula, Ilyocypris and Candoniella.

Representatives of the previous complex are sporadic here.

In this part of the section were found leaf reprints of the following plants: Salix alba L., Populus tremula L., Alnus hoernesi Star., Corylus avellana L., Ulmus suberosa L., Zelkowa caprinifolia Pall., Sorbus caucasigena Kom., Pyrus caucasica L., Ilex horrida Sap., Ligustrum vulgare L., Viburnum orientale Pall.

Thus in the above sections of the Akchagylian deposits are reported three complexes of the mollusk and ostra-

cod faunas.

On the basis of a regular distribution of facies types of sediments and complexes of mollusk and ostracod faunas the given serias of Akchagylian deposits is clearly subdivided into three strata: the lower (layers 1-18), the middle (layers 19-35) and the upper (layers 36-62). These strata can be correlated to the lower, middle and upper Akchagylian respecrively.

The Kvabebi fauna of vertebrates is associated to the middle part of the Akchagylian stage (layers 19-35).

Mammal bone remains form in Kvabebi the nest-shaped accumulations (thickness of the bone-bearing layer not exceeding 6m).

Animal remains are concentrated predominantly in the lower part of the bone-bearing layer, whereas the number of findings in the upper layers sharply decreases. There has been recorded no regularity in burial of remains of animal groups. As to the number of remains and variety of forms, predominant are Artiodactyla, representatives of Bovinae in particular. They are followed by Carnivora, Proboscidea and Perissodactyla. Rodents are presented by two isolated teeth only belonging to a porcupine.

As it follows from the above list, the Kvabebi faunistic complex consists of such typical representatives of the Russilionian fauna, as Machairodus davitasvilii, Anancus arvernensis, Ursus arvernensis, Dicerorhinus megarhinus, Hipparion crusafonti, Propotamochoerus provincialis etc., as well as Kvabebihyrax and numerous Bovinae, similar to ancestral for South African antelopes groups Parastrepsiceros, Oryx, Protoryx etc.

It should be mentioned, however, that the Kvabebi fauna is certain to contain elements of the lower Villafrancian fauna, having in its elements some carnivores

(Nyctereutes, Canis, Lynx), some Artiodactyla (similar to Leptobos, Eucladoceros etc.) and Hipparion crusafonti.

Despite a considerable diversity of the Kvabebi fauna, presence of mammal forms in it most peculiar to the "Russilion, along with the Early Villafrancian species, enables a correlation in time to the Russilionian and to partly to the Lower Villafrancian faunas consequently, the correlation of the Akchagylian to the West European Astian, Ruscinian and Lower Villafrancian.

Wednesday, May 31, 1972

Route: Signakhi - Tbilisi

Coming from Signaki down a steep and twisting road of the northern slope of the Kakhetinsky Range, the participants of the excursion go to Tbilisi over the Gombora pass making short stops in Tsinandali and Telavi.

From Signakhi to Telavi, and then toward the Shumata mountain, the Kakhetinskaya road runs along the southern margin of Alazanskaya valley in continental Akchagylian-Apsheronian bearing the local name of the Alazanskaya series. Going southwards, as one approaches the Gare-Kakhetinskaya depression, the Alazanskaya series is gradually replaced by Akchagylian marine deposits appearing for the first time in the Shwindkeli Range area.

In the true Alazanskaya series of the Upper Pliocene, in many places were found remains of fossil vertebrates. They have been found most abundant in the vicinity of the Malaani village, on the southern slope of the Kakhetinsky range. According to preliminary data, the Melaanian fauna is very similiar to the Kvabebian one. At present it is being studied.

As it has already been mantioned, the participants

of the excursion have to visit the village of Tsinandali, in the former the estate of the Georgian poet - duke A.G. Chavchavadze (father-in-law of a great Russian writer A.S. Griboedov); from Tsinandali they will go to the town of Telavi, where they will visit Batonis-Tsikhe, the residence of Tzars of Kakhetiya of the XVII-XVIII centuries. From the Tzar's Palace there can be seen the Cathedral Alaverdi situated on the right bank of the Alazani river. Alaverdi is a famous monument to old architecture of Georgia. It was built in the first quarter of the XI century.

Further, on the way to Tbilisi, the participants of the excursion will make stop near the oldest monument to Christian culture - Dzeveli Shuamta Monaster. It is one of the most magnificent architectural complexes of Georgia in the early feudalism. Basilica of the V-th century and two dome churches of the VII-th century remained preserved.

EXCURSION IN WEST AZERBAIJAN

The excursion in the area of the Transcaucasian depression along the routes of Tbilisi-Akstafa-Kushkuna, Kushkuna-Akstafa-Mingechaur-Duzdag-Tbilisi is aimed at the acquaitance of the Colloquium participants with the sections of Upper Pliocene (Eopleistocene) marine deposits in the districts of highlands Kushkuna (near the town of Akstafa) and Duzdag (near the town of Mingechaur). These sections are worth attention, since here, among marine deposits characterized by the Akchagylian and Apsheronian key fauna of mollusks there occur bone-bearing layers with mammal remains peculiar to the Khaprovian and Tamanian faunistic complexes (Fig.10).

The Kura depression is an eastern part of the Transcaucasian intermontane trough. This region is characterized by a rather wide distribution of marine Upper Pliocene deposits (Akchagylian and Apsheronian) that stretch almost continuously over the area between Tbilisi and Baku. On vast areas there can be traced continuous sections of marine deposits alternating with continental ones. The deposits are rich in fossil mammal remains that in a number of localities rest directly in coastal-marine layers together with mollusk shells (fig.11). This area together with localities of Georgia (Kvabebi) and of North Caucasus may be regarded as a type-region used for correlation of Upper Pliocene marine and continental deposits.

Until recently we had only a rough idea, to what subdivisions of the "marine" scale of the Upper Pliocene (Eopleistocene) do continental layers with one or another mammal fauna correspond?

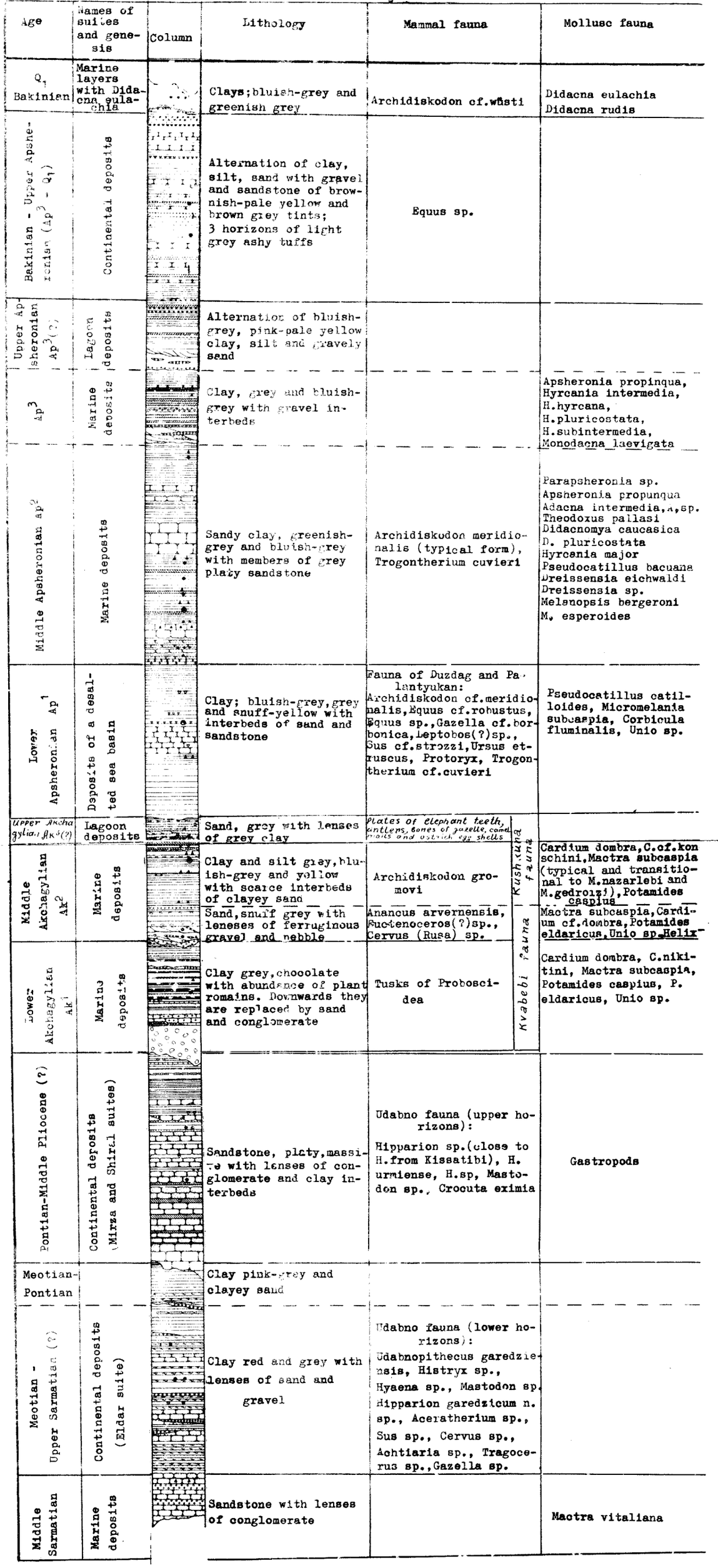


Fig. 10 . Position of bone-bearing layers with mammal remains in the summarized section of Pliocene and Quaternary of Adzhinaur

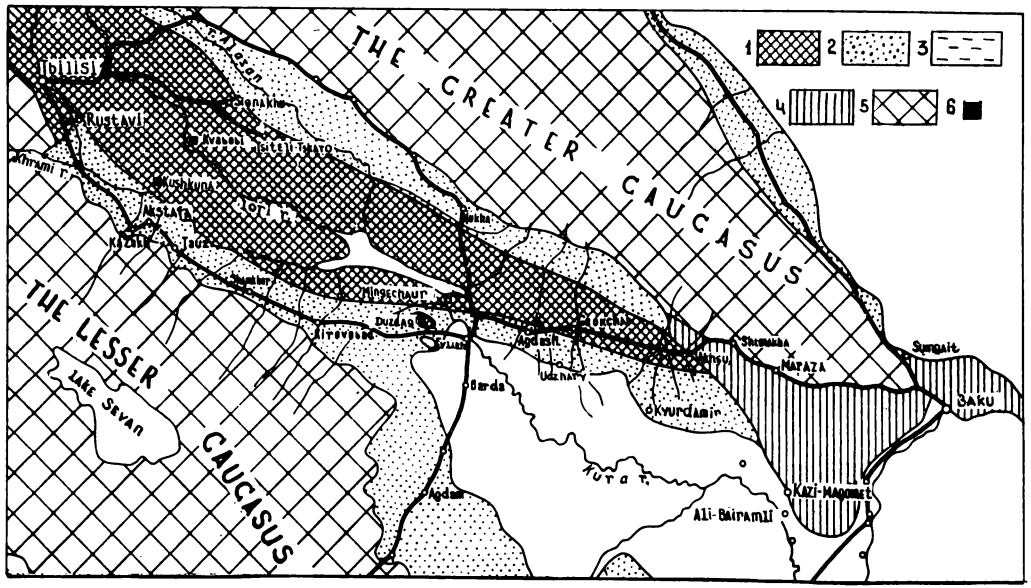


Fig. 11. Arrangement of sections with bone-bearing layers in the Kura depression area.

1 - Adzhinaur hills, 2 - Sloping piedmont plains, 3 - Alluvial plains and lowlands, 4 - Low-mountain relief of the Caucasus south-eastern margin, 5 - Mountain areas of Caucasus, 6 - Localities of mammal bone remains

Only seven localities of terrestrial mammal remains in dated Upper Pliocene marine layers were known. These remains of Archidiskodon gromovi Garr. et Alex. found by I.V. Kenner in the district of Grozny in the layers underlain by a series with Akchagylian mollusk shells were attributed to the Akchagylian; (Pavlova, 1931); dental remains of Elephantidae were found by K.A. Alizade in Akchagylian deposits near Naftalan and on the Bozdag, Duzdag and Palantekyan ranges. A jaw with teeth of Anancus arvernensis was found by Yu.P. Bazhenov in the Akchagylian deposits of Azerbaijan near the Akstafa mountain (Bogachev, 1962). S.L.Bertselius, K.A. Alizade, V.V. Bogachev recorded findings of elephant remains in the Apsheronian of Chuzgun-Tau and Bozdag (Borisyak and Belyaeva, 1948); V.V. Bogachev (1955) mentions the findings of hypparion remains in the Upper Apsheronian near the village of Shikhovo (Gabuniya, 1959); remains of Bison sp. were found in the Transcaucasian Apsheronian by Burchak-Abramovich (1949), A.A. Melikov pointed to the elephant remains in the Apsheronian of Duzdag in his report-manuscript for 1937.

The latest discoveries of bone-bearing layers in Upper Pliocene marine deposits of Georgia near Kvabebi (Gabuniya, Vekua, 1966) and Azerbaijan near Kushkuna and Duzdag (N.A. Lebedeva, 1972) enlarged the possibilities for correlation of marine and continental rocks. These findings and the new data obtained revealed at the same time some complications. The main of them consists in the fact that the faunas of Kushkuna Kvabebi found in marine deposits of the Akchagylian in localities remoted about 30km apart (Fig.12) differ considerably from one another, and the problem of their correlation has not been yet solved unequivocally.

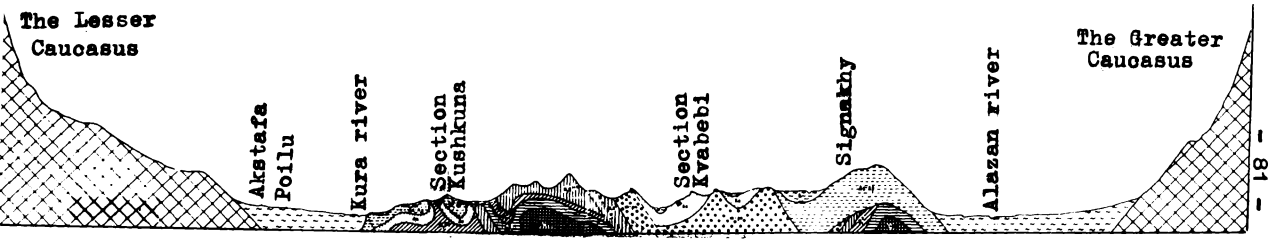


Fig. 12 . Schematic geological profile through the Middle-Kura depression

In the Akchagylian of Kushkuna were found animal remains that proved essential for the Khaprovian faunistic complex. The rich Kvabebi complex is rather peculiar, and, as some specialists believe, contains elements of the fauna that is older than the Khaprovian one, i.e. that is similar to the Russilionian fauna.

Since there can be no doubt as to belonging the deposits containing remains of the Kvabebi and Kushkuna mammals to the Akchagylian stage, the question arises, how shall we explain the significant differences observed in the composition of their faunas?

At the present day knowledge of geology and fauna of both localities the most reliable explanation of these differences seems to be their belonging to various horizons of the Akchagylian stage. Geological materials available provide good grounds for such an assumption. The mammals of the true Khaprovian complex in the section near Kushkuna occur in the uppermost parts of the Middle- and, perhaps, even in the Upper Akchagylian, whereas the locality of the fauna of Kvabebi mammals appears to belong to the lower horizons of the Middle Akchagylian, and partly to the Lower Akchagylian. One should also bear in mind that in the Transcaucasian area we deal with some peculiar fore-Asiatic province of the areal of the Villafrancian fauna of mammals with relics of old animal forms preserved under certain specific conditions of subtropical paleolandscape.

Thursday, June 1, 1972

Route: T b i l i s i - A k s t a f a - K u s h k u - n a - M i n g e c h a u r

The aim of the excursion is an examination of bone-bearing layers with mammal remains in Akchagylian marine deposits. Outcrops of Akchagylian bone-bearing layers are exposed at the distance of 25 km northward of the Akstafa town in the Adzhidere ravine that falls into the Kura river near the settlement of Poilu and begins under the Kushkuna mountain.

Locality 7. Section near the K u s h k u n a mountain (Akchagylian deposits).

The Kushkuna locality is situated in the area of the south-eastern periclinal subsidence of the anticlinal fold Mamedtepe. The fold is complicated by an overthrust along which the northern limb overlaps the southern one. In the core of this fold dumb volcanic-sandy rocks (layer 1) crop out on the day surface. On the limbs there become developed marine Akchagylian deposits and continental deposits that can be conditionally attributed to the Akchagylian-Apsheronian (Fig.13-14).

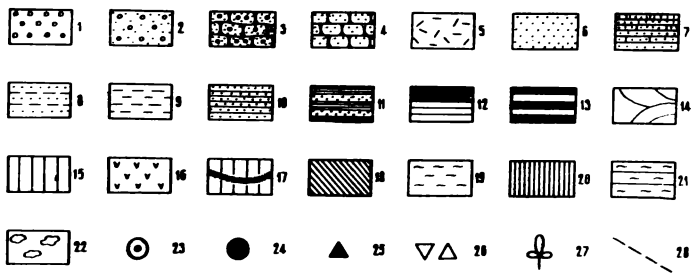
Description of the section (from below upwards):

1. Sand, grey and light-grey tufogene with a high content of volcanic glass, rounded fragments of dark obsidian, fine- and middle-sized grained, oblique-laminated, locally ferruginized, with lenses of grey clays. In some places of the sand roof an interbed of white tufogene sandstone remained preserved, it thickness being 1.5 - 2m.

S Y M B O L S

Figures I0,I3,I4,I5

I-conglomerates and coarse gravel;2-sandy-gravely deposits; 3-Sandstones with conglomeratic interbeds; 4-Sandstones; 5-Sands with an admixture of pyroclastic material; 6- Inequigranular sandstones; 7-Sandstones of clayey-sandy interbeds; 8-Clayey sands; 9- Silt;I0-Clays with sandy interbeds; II-Sands and sandstones with clay interbeds; I2-Sandy clays of various colours; I3-Grey clays with interbeds of chocolate lignitic clays enriched with plant remains; I4-Clays: grey,dark-grey and reddish-brown,lagoon-boggy; I5- Deluvial loams; I6-Ashy tuffs; I7-Horizons of buried soils; I8-Marls;I9-Sandy silts, sandy loams;20-Clayey silts;2I-Variegated clays; 22-Calcareous nodules Elephant; 23- Bone remains; 24-Mammal bone remains; 25-Shells of sea mollusks; 26- Shells of fresh-water mollusks;27-Remains of plant leaves and stems;28-Tectonic dislocations.



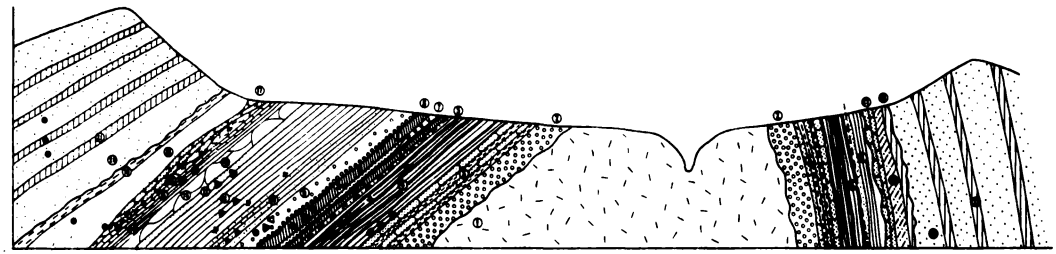


Fig.I3. Schematic section of the anticlinal fold in the southern slope of the Kushkuna mountain.

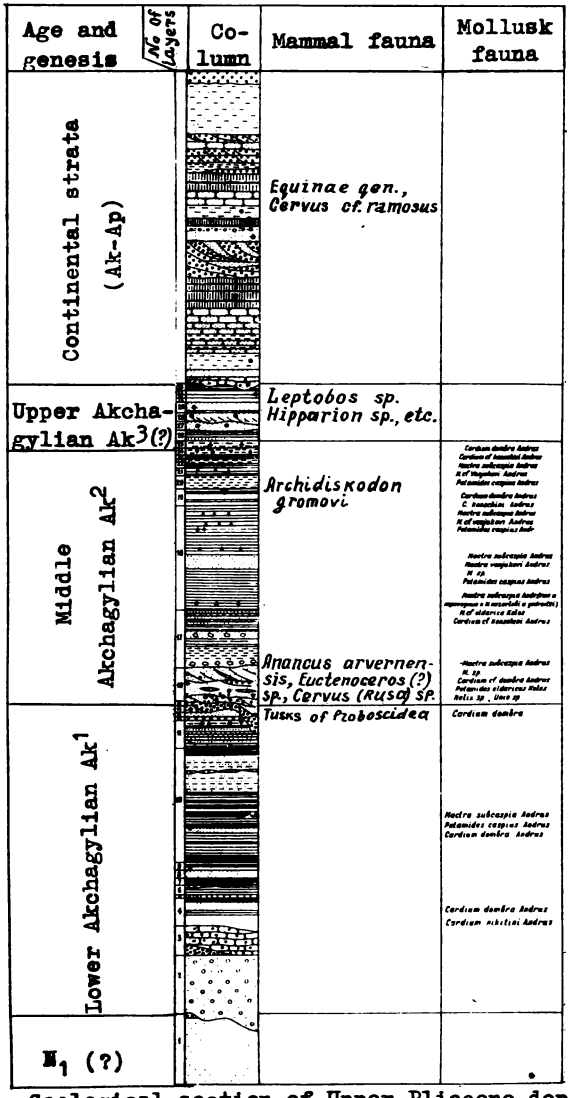


Fig.14. Geological section of Upper Pliocene deposits in the Kushkuna locality

Visible thickness 40.00m

2. Pebble and gravel, oblique-laminated, filled with grey coarse-grained sand. In the roof there can be found interlayers of compactly cemented conglomerate consisting of large pebbles of effusive and sedimentary rocks. They occur with well pronounced washout on layer 1 and form a basal horizon of abovelying Akchagylian strata.
Thickness 20.00-30.00m
3. Sand and sandstone coarse-grained with pebble lenses, ferruginized, frosty-brown.
Thickness 8.00-10.00m
4. Sand, grey, coarse-grained with interbeds of grey silt and clay.
Thickness 10.00m
5. Coquina, sandy, compactly cemented, yielding Cardium dombra Andrus.
Thickness 0.50m
6. Clay, grey, sandy with interlayers of grey fine-grained sand and an interlayer of light-grey volcanic ash in the roof.
Thickness 5.00m
7. Clay, book, shistous, lignite-like, chocolate-coloured, with plant remains.
Thickness 2.50m
8. Sand, clayey, grey.
Thickness 3.00m
9. Clay, bluish-grey with poorly preserved small shells Cardium dombra Andrus., Mactra subcaspia Andrus.
Thickness 2.50m
10. Strata formed by the intercalations of grey and yellowish grey clay, clayey yellow and grey sand

and siltstone. In the middle part there is a lense of oblique-laminated coarse-grained sand. Rather peculiar is the presence of lignite-like chocolate-coloured book clay with plant remains, from 1 to 3 m thick. They can be observed throughout the strata. There are also sporadic lenses with small shells Mactra subcaspia Andrus. and Cerithium (Potamides) caspius Andrus.

Thickness 40.00m

11. Intercalations of greyish-blue clay, grey sand and ferruginized brownish, grey siltstone. The layer is underlain and overlapped by horizons of grey-blue clay with reprints of plant leaves, sporadic shells Cardium dombra Andrus., Unio sp. and a great amount of shells of small thin-walled gastropods. There can be observed thin interbeds and lenses of lignite-shaped chocolate coloured clay.

Thickness 10.00m

12. White volcanic ash.

Thickness 0.50-1.00m

13. Sand, clayey, grey.

Thickness 1.50m

14. Silt, clayey and yellowish-grey with reprints of plant leaves, gastropod shells and sporadic unionides. In the layer was found a tusk of Proboscidae.

Thickness 0.70m

15. Conglomerate, hard, consists of pebbles of effusive and sedimentary rocks, with lenses of coarse-grained, grey, in places ferruginized sandstone. It rests with an abrupt washout on an underlying bed cutting in places its upper hori-

zons. The layer forms a basal horizon.

Thickness 0.50- 2.00m

16. Sand, coarse-grained, snuff-coloured, oblique laminated with interbeds and lenses of ferruginized pebbles and clayey pebbles. To this layer are associated findings of numerous bones of mammals. Predominant among them are remains of Anancus arvernensis Groiz. et Job. In addition to, rather frequent are fragments of antlers (Eucteноceros (?) sp., Cervus (Russa) sp.), gazelles and mails. Here can be also found shell of unionides, Helix and sporadic shells Mactra subcaspia Andrus., Cardium dombra Andrus., Cerithium (Potamides) caspius Andrus.

Thickness 12.00-15.00m

17. Sand, greenish-grey, flat laminated with interbeds of grey aleuritic clay and calcareous-sandy nodules. In the upper part there are interbeds of brown-grey platy sandstone. In the roof of the layer is developed a thin (0.3m) horizon of chocolate-coloured lignite-shaped clay.

Thickness 20.00m

L.P.Alexandrova determined here Mimomys ex. gr. polonicus-pliocaenicus, Villanyia penenyii (Mehely).

18. Clay, grey-blue, sandy, flat laminated, yellow and yellow-grey in the upper part. The clay contains conquina interbeds with Mactra subcaspia Andrus., M. venjukovi Andrus., Cerithium (Potamides)caspius (Andrus).

Thickness 35.00-38.00m

19. Clay, grey, dark-grey and reddish-brown. In the upper part of the layer, on the boundary of reddish-brown and dark-grey clay there occured a bone-bearing lense stretching over 18-20m, with remains of an elephant skeleton. Here were collected two preserved teeth, the third tooth - in fragments, a tusk, bones of a skull, large bones of limbs and ribs. The bones were resting in situ. According to V.I.Gromov's and V.E.Garrut's determinations, the remains belong to Archidiskodon gromovi Garr. et Alex.
Thickness 6.00m

20. Clay and silt - pale-yellow, flat-laminated.
Thickness 6.00 - 7.00m

21. Clay, bluish-grey with conquina interbeds, from which were defined Cardium dombra Andrus., C. cf. konschini Andrus., Mactra subcaspia Andrus., M. nazarlebi Alz., M. gedroitzi Koles., M. cf. eldarica Koles., Cerithium (Potamides) caspius Andrus.
Thickness 2.50m

22. Alternation of yellow and grey clay, silt and clayey sand.
Thickness 1.50 - 2.00m

23. Marl, whitish-grey.
Thickness 1.00m

24. Silt, light-grey with a mixed fauna of fresh-water gastropods, rare unionides and shells Cardium dombra Andrus.
Thickness 2.50m

25. Alternation of whitish and yellow-grey silt with a great amount of plant remains.
Thickness 2.00 - 2.50m

26. Platy flat-laminated sandstone and loose sand occurring with insignificant erosion on layer 25.
Thickness 1.50m

27. Sand, dark-grey and grey. The sand contains fragments of plates from teeth of Archidiskodon and antlers of Cervidae.
Thickness 3.00m

28. Sand and sandstone, light-grey, laminated, coarse-grained with bone remains of Leptobos sp., Hipparion sp., camels, turtles and ostrich egg-shells.
Thickness 2.50m

29. Clay, grey and greenish-grey.
Thickness 1.20m

30. Sand, clayey, yellowish-grey, spotty.
Thickness 2.00m

31. Clay, greenish-grey, laminated.
Thickness 1.50m

32. Clay, lilac-grey, laminated.
Thickness 2.50m

33. Clay, light-grey
Thickness 2.50m

With a wash out on underlying deposits occurs a series of continental rocks formed by an alternation of coarse-grained sandstone, conglomerate and deluvial loam concluding the horizons of light-brown buried soils. It contains a considerable amount of bone fragments of antlers, horse, turtles and ostrich egg-shells.
Thickness 100,00 - 120.00m

According N.A. Lebedeva, among Akchagylian marine deposits characterized by the mollusks fauna, three series can be clearly distinguished.

1. The Lower Akchagylian series, attributed roughly to the Sarmatian or Meotian, (layers 2-14) was formed by a peculiar complex of rocks with considerable participation of shistous lignite-shaped chocolate-coloured clay with plant remains. Here was found a very rare marine Akchagylian fauna with an admixture of fresh-water elements. Bone ramains in this series are sporadic.

This series is separated from the underlying continental rocks by a sharp erosion disconformity that can be traced on the adjacent sections and form one of the best pronounced, regionally expressed geological boundaries of this region.

The stratigraphical position of the series and peculiarities of its lithological composition, as A.A. Alizade believes, reminds well enough the Lower Akchagylian sections in eastern regions of Azerbaijan and Turkmenia.

2. The middle series (layers 15-17) consists of coarse-grained and sandy rocks, where, together with common marine mollusks, are found fresh-water forms too. The sands of this series are bone-bearing. Among a great amount of animal bones, predominant are Mastodontidae, whereas elephant remains not being observed at all. It is very likely that in the future one can manage to correlate this fauna to the Kvabebi fauna from the Georgian Akchagylian. A.A. Alizade assigns this series to the Middle Akchagylian.

3. The upper series is presented predominantly by clay rocks (layers 18-25) and is characterized by a relatively abundant and diverse Akchagylian mollusks, though small and large shells are prevailing here. According to A.A. Alizade's opinion, this series can be attributed to the Upper Akchagylian.

According to N.A. Lebedeva's data, series 2 and 3

belong to the same sedimentary cycle of the Middle Akchagylian, since no somewhat noticeable gap was recorded between them. A.G. Ebersin was of the same opinion following the data of an analysis of the marine fauna obtained from these deposits.

The remains of Archidiskodon gromovi Garr. et Al. are associated to the upper third of the Middle Akchagylian in this sense.

Akchagylian deposits characterized by the marine fauna are overlapped by sediments (layers 26-33) of nearshore marine genesis devoid of the mollusk fauna resting on the sea layers without any traces of intense washout. N.A. Lebedeva attributed them conditionally to the Upper Akchagylian. The bone-bearing layers of this sediments are characterized by presence of considerable number of dental plates of Archidiskodon. This series with washout is overlapped by sandy-gravel deposits attributed to the Akchagylian-Apsheronian.

After the examination of the Kushkuna locality the buses with participants of the Colloquium return to the town of Akstafa, and then go eastwards, alond the road Tbilisi-Baku, to the town of Mingechaur for the night.

Friday, June 2, 1972

Route: M i n g e c h a u r - D u z d a g - M i n g e c h a u r

The route is devoted to the acquaintance with the position of bone-bearing layers containing the Tamanian fauna of mammals in the section of marine Apsheronian deposits of the Duzdag mountain toward the south-west of the town of Mingechaur. The excursion buses start from the

Mingechaur tourist camp, come back to the main highway and move westwards to the railway station of Geran. Then the buses turn northwards along the side highway to the Duzdag mountain that can be seen in the distance. This is a small island hill the slopes of which are cut by gorges and ravines forming in some places badlands. The Duzdag mountain is a brachy-anticlinal fold of the sublatitudinal strike with the Akchagylian in the core. On its northern limb Apsheronian and Bakinian deposits are developed. Layers with remains of elephants, beavers, horses, not defined to a species, oxen and numerous fragments of ostrich eggshells, were found in the western part of the northern limb of the fold, on its periclinal subsidence. The northern slope consists here of a series of cuesta-like ridges.

Locality 8. Section near the D u z d a g mountain (Apsheronian deposits)

On the Akchagylian marine layers there occur: (from below upwards):

1. Sandstone, pale-yellow with conquina lenses, with Cardium dombra Andrus., Mactra subcaspia Andrus., Cerithium (Potamides) cespius Andrus.
   Thickness 15.00m
2. Clay, greenish-yellow, flat-laminated.
   Thickness 60.00m
3. Clay grey and dark-grey sandy, contain sporadic remains of shells: Pseudocatillus cf. catilloides Andrus., Micromelania sp., M. subcaspia Andrus., Adacna plicata Eichw.
   Thickness 15.00m
4. Sandstone, platy, spongy, grey, with small con-

glomerate lenses, form steep cliffs and fantastic figures of weathering. Contain sporadic shells of unionides, Corbicula fluminalis apscheronica Andrus. and ostrich egg-shells.

Thickness 25.00m

5. Clay, sandy greenish-grey with interlayers of compact clayey sandstones of the same colour. In their roof there is a horizon of greenish sandy clay with an interlayer (about 0.5m) consisting of shells Crassunio cf. crassa (Retz.), Potomida sp., Psilunio sp., Cuncopsis sp., Unio sp. In this layer were found in situ remains of Archidiskodon cf. meridionalis Nesti (according to V.I. Gromov).

Thickness 4.00 - 5.00m

6. Alternation of whitish-yellow, light-brown, bluish-grey clay and clayey, spongy sandstone of yellow-brown colour.

Thickness 15.00m

7. Clay, bluish-grey, grey and brown. In clays are observed sporadic nests with lenses of Corbicula fluminalis apscheronica Andrus. and fresh-water gastropods.

Thickness 40.00m

8. Sandstone, light-brown; in its roof there is one-metre bed of grey sandy clay.

Thickness 2.50m

9. Sand, grey with pebble, passes upwards into sandstone with lenses of loose sand and clay. Occurs on layer 8 with slightly pronounced washout, forming the basal horizon of the abovelying series.

Thickness 5.00m

10. Alternation of sandstone, greenish-grey, coarse-grained sand and grey sandy clay. There are numerous interbeds in the strata with shells of marine Apsheronian mollusks: Apsheronia propinqua Eichw., Pseudocatillus sp. indet., Melanopsis bergeroni Sabba, M. esperoides Sabba, Adacna sp. indet., Theodoxus pallasi Lindholm.
Thickness 20.00m

11. Sandstone, ferruginized, coarse-grained, spongy, form abrupt cliffs and collapse near the foot of cliffs.
Thickness 8.00 -10.00m

12. Conquina of pale-pink colour, consists of shells: Apsheronia propinqua Eichw., Didacnomya pluricostata Andrus., Hyrcania major Andrus., Melanopsis bergeroni Sabba.
Thickness 5.00 - 6.00m

13. Clay, sandy, bluish-grey, with interbeds of sandstones with shells: Apsheronia propinqua Eichw., Didacnomya pluricostata Andrus., Didacnomya caucasica Andrus.
Thickness 15.00m

14. Clay, sandy, compact, olive-grey, contains a destroyed skull of an elephant with two tusks and fragments of teeth[x]. According to defini-

[x] The elephant skull was found on a periclinal subsidence of the bone-bearing layer in a small remnant hill, its belonging to the Middle Apsheronian layers being traced in the area.

tion by V.I. Gromov and V.E. Garutt, the remains belonged to a typical species of the southern elephant - Archidiskodon meridionalis Nesti, the key form from the Tamanian faunistic complex. In the upper part of the layer shells of Apscheronia propinqua Eichw., Parapscheronia sp. were determined.

Thickness 6.00 - 8.00m

15. Alternation of sandy olive-grey and grey clay and clayey grey sand. In the layer are observed many indefinable fragments of large mammal bones and sporadic remains of Apscheronia propinqua Eichw., Dreissensia sp., Adacna sp., Theodoxus pallasi Lindholm.

Thickness 50.00m

16. Sandstone, platy, grey, cavernous; form steep cliffs.

Thickness 25.00m

17. Alternation of greenish-grey and yellow sandy clay and yellow-grey sandstone.

Thickness 30.00m

18. Sandstone, grey with sandy interbeds and lenses of gravel; contain shells of Apscheronia propinqua Eichw.

Thickness 20.00m

19. Alternation of clays and silt: pale-yellow, bluish-grey, brown, olive; at the distance of two metres from the roof there lies a marker horizon of ferruginized orange-yellow clay. In the middle part of the layer were found bone remains and teeth of Trogontherium cf. cuvieri.

Thickness 30.00m

20. Sands, cross-bedded, coarse-grained, dark-grey and bluish-grey with lenses of pebbles and gravel, occur on layer 19 with washout.

Thickness 15.00m

21. Conglomerate of large pebbles filled with dark-grey clayey sand.

Thickness 2.50m

22. Alternation of dark-grey sandy clay, dark-grey sand and gravel.

Thickness 10.00 -12.00m

23. Conglomerate of large pebbles filled with dark-grey clayey sand.

Thickness 2.00m

24. Alternation of dark-grey and bluish-grey clay, silt, clayey sand with gravel. The upper part of the layer contains Apscheronia propinqua Eichw., reprints of Hyrcania ex. gr. intermedia Eichw.

Thickness 15.00 - 17.00m

25. Conglomerate of large pebbles filled with clayey dark-grey sand.

Thickness 2.50m

26. Clay, bluish-grey, sandy; includes nests of shells: Apscheronia propinqua Eichw., Hyrcania intermedia Eichw., H. hyrcana Andrus., H. pluricostata Sinz., H. subintermedia Andrus., Monodacna laevigata Andrus. This layer is the last containing the marine Apsheronian fauna in the given section.

Thickness 2.50m

27. Clay, bluish-grey, arenaceous, similar to that in layer 26, but devoid of fauna.

Thickness 15.00m

28. Sand, dirty-grey with lenses of pebble and gravel, pass upwards into diagonal-laminated sandstone. They form a basal horizon of the abovelying strata. Judged by the character of lamination, these are deposits of a delta (probably of a subsurface delta). Contain a great amount of indefinable fragments of large mammal bones and ostrich egg-shells.

Thickness 20.00m

29. Alternation of yellow, bluish-grey, pinkish-grey, fine-grained clayey sand, silt, clay of a lagoon type; in the upper part of the layer there appear gravel lenses.

Thickness 40.00 - 45.00m

30. Alternation of alluvial-proluvial sand, silt and grey sandy clay, with packets of platy coarse-grained sandstone. On the contact with layer 29 there occurs an interbed of light-grey ashy tuff 1.5-2.0m thick. In the upper part of the layer, in sandy brown clay were found bones of horse limbs that could not be defined to a species.

Thickness 70.00m

31. Sand, loose, coarse-grained with gravel and pebble.

Thickness 10.00m

32. Alternation of whitish clay, loam with packets of grey and light pale-yellow sandstone.

Thickness 50.00m

33. Alternation of alluvial-proluvial orange-brown

clay with packets of grey platy sandstone and gravel dark-grey sands. 5 metres from the foot, and 10-12 metres from the roof of the layer there are two horizons of white and light-grey volcanic ashy tuff of 0.5 to 1.5 m thick.

Thickness 50.00 - 55.00m

34. Pebble in coarse-grained grey gravel sand, makes up a basal horizon of the abovelying Bakinian marine strata occuring on layer 33 with washout.

Thickness 0.75 - 2.00m

35. Alternation of marine grey and brown clay, silt, fine-grained sand with interbeds of conquina containing Bakinian mollusk shells.

Thickness 35.00 - 37.00m

Thus, marine Apsheronian deposits of the Duzdag, containing mammal remains, are divided into three parts. Their boundaries between one another do not resemble sudden geological gaps. In general terms the section of the Apsheronian Duzdag can be regarded as a single series of rocks that vary regularly from below upwards. However, one can observe in the character of deposits and fauna of marine mollusks certain changes along the section. This enabled the geologists and paleontologists working here to attempt a distinguishing of all the three substages of the Apsheronian stage: Lower, Middle and Upper. Most scientists (I.A. Melikov, M.A. Osepyan, K.M. Sultanov, K.A. Alizade, A.A. Alizade et al.) distinguish the following series: 1 - the L o w e r Apsheronian presenting the conditions of a desalted basin with sporadic fauna : Adacna plicata Eichw., Pseudocatillus catiloides

Andrus., Micromelania subcaspia Andrus., Clessiniola sp., Corbicula fluminalis apscheronica Andrus.

To the lower Apsheronian in the given section are attributed layers 2-8 which contain in the upper third remains of Archidiskodon cf. meridionalis Nesti.

In the Lower Apsheronian of the adjacent area was found a more diverse mammal fauna that enables to extend the list of animals peculiar to the lower substage of the Apsheronian. Thus in the Palantekyan range situated northwest, near the Plovdji pass, over the settlement of Poily are developed similar sandy clayey deposits of the desalted lower Apsheronian. Among defined fresh-water mollusks there are: Corbicula fluminalis apsheronica, Fagotia esperoides, Margaritifera arca - a typical representative of the complex with Unio sturi. Here were also found bone-bearing layers with remains Equus cf. robustus, Equus sp., Gazella cf. borbonica, Leptobos (?) sp., Sus cf. strozzi, Ursus cf. etruscus, Protoryx sp., Trogontherium cf. cuvieri, turtles and ostrich egg-shells.

2. To the Middle Apsheronian on the Duzdag mountain is attributed by the most geologists the series that reflects the epoch of maximum transgression and has the most abundant and diverse fauna of marine mollusks.

In the given section (Fig.15) to the same characteristic corresponds two hundred metres thick series (layers 8-19) that contains abundant diverse fauna of marine Apsheronian mollusks. In its lower quater, 55m higher the foot, there were found remains of Archidiskodon cf. meridionalis Nesti. (Tamanian faunistic complex).

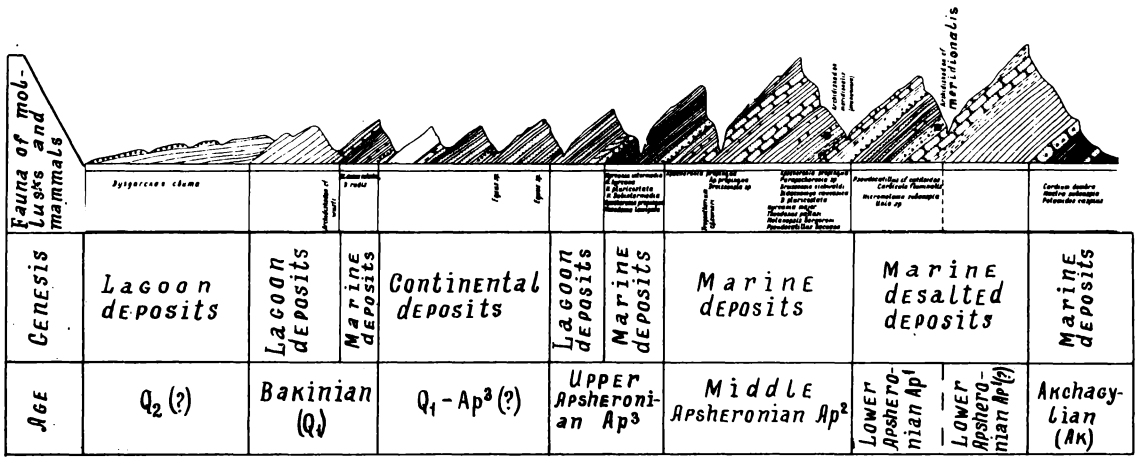


Fig. 15 . Schematic geological profile of the Duzdag western part

3. The distinguishing of the Upper Apsheronian in the Duzdag locality remains under question. Some researchers believe that it is expressed here in the continental facies only, attributing to it the sub-Bakinian series (layers 28-33 of the given section). The others say that its lowermost parts embrace marine deposits as well.

In the above section the marine layers 20-27, and conditionally the lagoon layers 28-29 are attributed to the Upper Apsheronian.

There are few mammal remains collected from the Upper Apsheronian of the Duzdag (if not considering horse remains from the continental deposits); yet, the supposed analogues of these deposits near the village of Enikend contained remains of Archidiskodon cf. meridionalis Nesti. As V.I. Gromov believes, this form is more progressive than a southern elephant from the Tamanian complex and seems to correspond to the fauna of the uppermost horizons of the Upper Pliocene.

Samples for paleomagnetic studies have been collected from the Akchagylian, Apsheronian and Bakinian deposits of the Duzdag mountain. An interval in sampling from Akchagylian and Lower Apsheronian sediments was 4-5m; that from abovelying Apsheronian - 10m, and from Bakinian (layers with Didacna eulachia) - 2.3 - 3m. Altogether 110 samples were collected.

It has been established by means of paleomagnetic studies that the most part of rocks of the section had a reverse magnetization. Rocks with normal magnetization were found in deposits with Didacna eulachia, in the upper part of the Middle Apsheronian and in the lower part of the freshwater strata attributed to the Lower Apshe-

ronian on the boundary with marine Akchagylian deposits.

It follows from the analysis of paleomagnetic data obtained from the Duzdag section, and a number of sections of other regions of Azerbajjan, where paleomagnetic studies of marine deposits of the Akchagylian, Apsheronian and Bakinian age were carried out, that in the Duzdag section a zone of normal magnetization fixed in Middle Apsheronian deposits corresponds to Djaramillo event of Cox scale (1969). The zone of normal magnetization found in Lower Apsheronian fresh water deposits corresponds to Gilsa event or to its part.

Thus, we can assume the absolute age of elephant bone remains found in layers 5 and 14. These layers rest on a series of reversal magnetized rocks between Gilza and Djaramillo events. Therefore, their age is not younger than 1mln. years (lower boundary of Djaramillo event), and not older than 1.6 mln. years (upper boundary of Gilza event).

After the examination of the Duzdag locality the participants of the excursion return to the tourist's camp near the Mingechaur Lake for the night.

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