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THE CRIMEAN AUTONOMOUS SOVIET SOCIALIST REPUBLIC

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GEOGRAPHICAL AND GEOLOGICAL SKETCH OF THE CRIMEA

By *A. MOISSEIEV*

The Crimean Peninsula, which constitutes a part of the Crimean ASSR, is situated between 44°23′ and 46°21′ N. latitude and 32°30′ and 36°40′ E. longitude. The narrow Isthums of Perekop connects the peninsula with the Ukraine. From north-southward, i. e. from town Perekop to cape Sarych on its southern coast, the peninsula stretches approximately over 195 km, and from west-eastward, in its widest part it covers 320 km. The total area of the Crimea is 25 900 sq. km.

By its relief the Crimea may be divided into three major natural regions: the Mountainous Crimea, the Steppe Crimea and the Kerch Peninsula.

The Mountainous Region (Crimean Mountains) occupies the extreme southern part of the peninsula. Its length is 150 km and its width, 50 km. The Main Ridge is distinguished in the south of this region and monoclynal crests in its northern part. The Main Ridge is often called the First Ridge. On the area of monoclynal crests are distinguished the Second (middle) and the Third (northern) Ridges. The Second and Third Ridges are separated by a longitudinal valley and are most distinctly displayed in the region of town Simferopol.

The Main Ridge is formed of Triassic, Jurassic and partly of Cretaceous rocks; its summit is known under the name of Yaila, a Tartarian word, meaning „pasture". The Yaila Range is characterized by its karst landscape — here are encountered caverns with stalactites and stalagmites. The maximum height

of the Main Ridge is 1543 *m* (Mount Roman-Kosh on Babugan-Yaila).

The Second Ridge is formed of Cretaceous and Paleogene rocks; it rises to altitudes of about 500 m. The Third Ridge is formed of Paleogene and Neogene rocks. Its height is about 300 m and it represents the southern boundary of the Steppe Crimea Region. Through the central part of the latter passes the watershed between the sea of Azov and the Black Sea. In its southern part this watershed attains an elevation up to 90 m above sea level. For the southern part of the Steppe Region is characteristic an undulating erosional relief (the land surface being broken by numerous ravines) which is less pronounced near the sea. The north-eastern coast of the Steppe Region is extremely dissected forming a succession of capes, peninsulas, gulfs and bays. Here in some places the coast is steep and abrupt, in others it slopes gently towards the vast interior water basin, called the Sivash or „Putrid Sea". The Sivash Sea is separated from the Sea of Azov by the narrow Arabat Arrow running from the Kerch Peninsula. The western extremity of the Steppe Region is known under the name of Tarkhankut Peninsula. Its maximum elevation is 185 m above sea level. In the Eupatoria and Perekop districts of the Steppe Region are present salt lakes, — which are separated from the sea by narrow sand spits.

The Steppe Region is connected with the Kerch Peninsula by the Akmanai Isthmus. The Parpach Ridge (115 · 5 m) divides this peninsula into the south-western lowland region and the northern and south-eastern mountainous part with deep depressions and hollows. A peculiar feature of this latter part is its bizarre, ring-like, elliptical or crescent-shaped ridges which were formed in result of the erosion of anticlines. The highest points of the peninsula are the summits of the Mithridates Ridge (183.2 m) and Mount Opuk (183.2 m).

The most important rivers of the Crimea are the mountain streams of the northern slope: Chernaya, Belbek, Kacha and Alma, discharging into the Black Sea, and the Salghir River with its tributaries Angara, Beshterek, Zuya, Burulcha, Biuk-Karasu; then the Bulganak and Indol rivers (discharging into the Sea of Azov); on the southern slope of the mountains are present short rivers poor in water: Uchan-su, Ulu-Uzen, etc.

All the rivers of Crimea are poor in water, in summer during years of drought they are practically dried up.

As to its climate, the Crimea occupies a favourable position, thanks to the abundance of light and warmth. The climate of the Crimean Autonomous Socialist Republic depends on the influence of the surrounding seas. Thanks to this influence the winter in the Crimea is much warmer, and summer cooler than in the adjoining parts of the South of the USSR.

The mean annual quantity of sunny hours amounts to 2500 [being 1560 in Moscow, 1680 in Piatigorsk, 2000 in Kislovodsk, 2154 in Sochi and 2888 in Palermo (Italy)].

In different localities of the Crimea the maximum annual number of days with the sun absolutely concealed by clouds varies from 52 to 56. The Crimea is characterized by having much variety of climate.

The climate of the steppe zone as compared with that of the Southern Coast of the Crimea is characterized by severe winters accompanied by strong winds, frequent, intermittent snow-storms; the temperature in the Steppe Crimea falling maximally to — 20° C on frost days. The mean annual temperature is about 11° C. The coldest month of the year is January.

The climate of the mountainous part of the Crimea varies with altitude. In the northern piedmont ranges of the Crimea the temperature varies from 10° to 12° C. The amount of precipitation varies from 400 to 700 mm.

At the summit of the Yaila (Ai-Petri) the mean annual temperature is 5.8° C and the amount of precipitation up to 1000 mm.

The Southern Coast of the Crimea being protected by the Yaila which rises to an altitude of 1500 m above sea level, is distinguished by its even climate, temperature variation being not sharp.

On the Southern Coast, in the town of Yalta, after observation data for 57 years, the mean annual temperature is 13.1°, and the mean relative humidity, 68%. The mean annual temperature (13.1°) of the Southern Coast of the Crimea approaches that of Venice and is but 2° lower than that of Nice.

As compared with the Black Sea Coast of the Caucasus the Southern Coast of the Crimea is characterized, as regards precipitation, by following figures: Yalta — 550 mm; Sochi, Gagry — 1500 mm; Batum — 2400 mm.

The number of rainy days is not great on the Southern Coast (70), being 75 in Nice and up to 135 on the Caucasus Coast.

The climate of the Southern Coast of the Crimea may be characterized as a moderately dry one. The most arid month is August. Autumn is the driest season not only in the Crimea, but also as regards the whole of the European Part of the Union. The climatic conditions of the Southern Coast are exceedingly favourable for the treatment of various diseases and the restoration of health in general.

Near the Isthmus of Perekop and Sivash Sea are distributed alkaline soils and salt marshes; in the Steppe Region are developed chestnut (chernoziom) soils; in the Mountainous Region are distributed mountain-forest and meadow soils and chernoziom soils. In a number of localities are also present true red soils (krasnoziom).

The lowland part of the Crimean Peninsula is covered with grassy vegetation. In the foreland region a woody-steppe zone is present, and in the Mountainous Region grows a timber wood (oak, white beech, maple, ash, beech, pine, etc.). The summit of the mountains (Yaila) represents a stony plateau covered with a grassy turf. On the Southern Coast grow along with the above mentioned woody vegetation arboraceous junipers, the mastic tree (*Pistacea mutica*), the strawberry tree (*Arbutus andrachne*). Cypress, magnolia, laurels, palms and other evergreen trees and shrubs are also here cultivated, also grape-vine, tobacco, olives and medicinal plants. The vegetation of the Southern Coast bears the character of a much impoverished Mediterranean flora.

The mammals are poorly represented. From big game in the Crimean forests live only the roe-buck (*Capreolus*) and the red-deer (*Cervus elaphus*), the shooting of which is prohibited. The ornitho-fauna, the fauna of reptiles and amphibians is also scanty.

Concerning the origin of the vegetable and animal reigns of the Crimea different opinions have been expressed by zoologists and botanists. All these explorers, without denying the fact of migration of the flora and fauna from the region of the Ukraine, admit also the possibility of such a migration either from Transcaucasia, or else from Asia Minor and the Balkans.

Basing upon data given by some biologists, geographers and geologists a hypothesis of the existence in Tertiary time of a continent connecting the Crimea, Transcaucasia, Asia Minor and the Balkans (Pontida) was proposed. This land was submerged by the close of the Pliocene and the outset of the Quaternary period. Some other geologists, however, are pointing to the great antiquity of the Black Sea depression and putting in doubt the very existence of the Pontida.

The history of the colonization of the Crimea embraces thousands of years. Due to its physiographic conditions, its position on the outskirts of the Russian Plain and on the routes of communication with the Mediterranean regions, Crimea has for long been a country to which migrated the peoples of the Palaeolithic and Neolithic ages, the half mythical Cimmerians and Tauri, the ancient Greeks, the Romans, Gothes, the Huns, the Khazars, Tartars and finally the Russians.

Most interesting relics of antiquity are found in town Kerch (Scythian and Ancient Greek), in Theodosia and Sudak (Genoese), Ai-Todor (Roman), in Chersonesus (Ancient Greek, Roman, Byzantine), in Balaklava (Genoese), Inkerman, Cherkes-Kermen, Mangup-Kale, Tepe-Kermen (ancient cave towns) and in Bakhchisarai (Tartarian).

The population of the Crimea consists chiefly of Russians, Ukrainians, Tartars. Before the Revolution the industrial development of the Crimea was very low, and it has been chiefly an agricultural region. Up to 71% of all land was in the hands of rich landowners and other private persons. At present the passage to collective farming is nearly completed. The collective farms are equipped with the modern agricultural machines. There are organised many machine tractor service stations due to which the yielding capacity of land was raised and thus the welfare of population attained. New industrial centres are created and many old ones reconstructed (e. g. the Kerch Combined Metallurgical Works, the Sevastopol Ship-building Works, the Saki Chemical Plant, tinned food industry, etc.).

As regards the cultural development of the region after the Revolution, the liquidation of illiteracy is now accomplished, obligatory seven-year education introduced, as well as a specially elaborated Neo-Turkic alphabet for the use of the local

population; many Higher Educational Institutions (Pedagogical and Medical Institutes), Technical Schools and Workers Faculties founded, etc.

In the Steppe Crimea from economic activities those of importance are agriculture (wheat cultivation), cattle-breeding, the extraction of salt and quarrying of building material.

In the Mountainous Region a great rôle is assigned to industrial horticulture and tobacco production; the Southern Coast is an important grape and tobacco producing area.

The Kerch Peninsula after the Revolution became a very important centre of mining industry due to the construction here of an iron-ore conditioning plant and other mining industry enterprises.

The Crimean Autonomous Socialistic Soviet Republic occupies one of the first places by the abundance and variety of its salubrious natural forces and is of All-Union importance as regards health-resorts.

In the pre-revolutionary years the exclusively favourable climatic conditions and other medicinal forces of the Crimea were but quite insignificantly utilized and inaccessible to the broad masses of the population of the country. After the Great October Socialist Revolution the villas of private persons and the palaces of former tsars, grand-dukes and princes have been utilized for the installation of sanatoriums and other medicinal institutions; moreover, a number of new buildings for various medicinal institutions have been erected.

Stratigraphy. The Crimean Peninsula is built up of Lower Permian, Upper Triassic, Jurassic, Cretaceous, Tertiary and Quaternary deposits.

In the Mountainous Crimea the Lower Permian is represented by limestones, including a fauna of brachiopods, trilobites, fusulinids, etc. These limestones are distributed in the form of small blocks amidst Lower Jurassic and Triassic deposits.

The Upper Triassic consists of argillaceous shales with *Pseudomonotis caucasica* Witt. and *Halobia* sandstones and rarer limestones including brachiopods (*Spirigera oxycolpos* Emm., etc.). The Upper Triassic plays an essential part in the structure of the Main Ridge.

The Lower Jurassic is represented by argillaceous shales, sandstones and limestones with an abundant fauna of brachiopods. These deposits are widely distributed on the area of the Main Ridge.

The unclassified deposits of the Upper Triassic and Lower Jurassic in the Crimea are referred to the series of the so-called „Tauric shales".

The Middle Jurassic consists of argillaceous shales, sandstones which are often tuffaceous and contains coal and plant remains. Rarer are encountered limestones with brachiopods. Of these deposits faunally well-characterized are the Bajocian and the Bathonian stages. The Middle Jurassic is distributed on the area of the Main Ridge. In the central part of the Mountainous Crimea the Middle Jurassic deposits are absent (at the base of the Upper Jurassic).

The Upper Jurassic extends throughout the entire area of the Crimean Mountains, constituting the summit of the Main Ridge, and is characterized by an extreme variability of facies.

The Callovian is represented by argillaceous shales, sandstones and limestones; it is characterized by a cephalopod fauna and is distributed only in the extreme south-western and north-eastern parts of the Mountainous Crimea.

The presence of the Oxfordian has up to now not been ascertained in the Crimea.

The Lusitanian is mainly represented by limestones, conglomerates and sandstones. The limestones include a rich fauna of corals, sponges, echinoids, pelecypods and brachiopods.

The Kimeridgian consists of compact and bedded, grey or reddish limestones, marls and coarse conglomerates. The limestones and marls contain a fauna of corals, echinoids, brachiopods, pelecypods, gastropods and rarer cephalopods.

The Tithonian is built up of grey limestones and marls, including ammonites.

The Lower Cretaceous is distributed on the area of the Second Ridge and in places on the slope of the Main Ridge being characterized by great lateral variation.

The Valanginian includes clays, marls and sandstones with cephalopods.

The Hauterivian mainly consists of limestones with a rich and varied fauna, and rarer of clays.

The Barremian is mainly built up of limestones with a rich fauna or of clays with belemnites and ammonites.

The Aptian consists of clays with belemnites.

The Albian includes clays and sandstones.

The Upper Cretaceous is distributed on the area of the Second Ridge. In the Central part of the Mountainous Region, near town Simferopol, Upper Cretaceous deposits are absent.

The Cenomanian consists of argillaceous marls with cephalopods.

The Turonian — of white marls and fossiliferous limestones with flints.

The Senonian (Coniacian, Santonian, Maastrichtian stages) is also represented by a thick series of white marls.

The Danian stage consists of bryozoary limestones with a rich and varied fauna and of arenaceous marls with echinoids.

The Paleogene is distributed on the area of the Second Ridge and at the base of the Third. The Maikop series is widespread in the south-western plain of the Kerch Peninsula.

The Paleocene is represented by limestones and marls.

The Eocene — by nummulitic marls and limestones (Lutetian stage) and white marls (Bartonian stage).

The Oligocene consists of marls and clays grading imperceptibly into Lower Miocene deposits (Maikop series).

The Miocene consists of marine deposits of the Tarkhan, Chokrak, Karagan and Konka beds, represented by sands, clays, marls, limestones, and of brackish-water deposits belonging to the Sarmatian and Maeotic stages, represented by limestones, clays and sands.

The Pliocene is built up of Pontian, Cimmerian, Kuyalnik stages, and the Taman, Krasnokut and Chauda beds.

The Lower Pliocene consists of various brackish-water limestones, whereas the Upper Pliocene is mainly represented by continental deposits.

Miocene and Pliocene deposits are distributed in the Steppe Crimea, on the Kerch Peninsula and on the summit of the Third Ridge.

The Quaternary system mainly includes continental and partly marine recent and ancient deposits forming the coastal terraces. The continental terraces may be most distinctly observed in the Mountainous Crimea, where four steps of them are present.

Volcanic activity. In the Mountainous Crimea outcrops of igneous rocks occur on areas where Triassic, and Lower and Middle Jurassic deposits are developed. They form more or less large intrusive bodies — laccoliths (mounts Aiu-dagh, Kastel, Chamny-burun, Uraga, etc.).

Besides, there are present complex tuffs and lavas series and rather often are encountered small effusive massifs. The magmatic rocks are represented by hornblende adamellites and banatites, quartz porphyries, keratophyres, quartz diorites, diabases, plagioclase-pyroxene porphyrites, etc. The magmatic rocks are genetically closely related and belong to one and the same petrographical province. The eruptions are referred to the Bajocian and Bathonian and possibly to the Callovian ages. In the region of town Balaklava are present tuffs of Lower Cretaceous age.

Orogenesis, Epeirogenesis, Transgressions and Regressions. It is possible, but unproved, that by the close of the Permian period there took place mountain forming processes and a marine regression. On the boundary of the Rhaetic and Lower Liassic ages orogenic movements were also quite possible (hypothetical Salghir subphase), at the close of the Liassic occurred the Donetz subphase; between the Callovian and Lusitanian, in the Lower Oxfordian time — the Yaila phase; at the close of the Kimeridgian or during the Lower Tithonian — the Andian subphase. Movements are possible up to the Hauterivian. The writer distinguishes all these Mesozoic movements as the Chersonian orogeny (Cimmerian). Insignificant uplifts took place before the Albian. Sharp movements are observed on the boundary of the Maastrichtian and Danian ages. On the boundary of the Paleocene and Eocene vigorous movements and disjunctive dislocations, connected with same, occurred.

In the Mountainous Crimea after the close of the Oligocene and up to the Chokrak age vigorous uplifts took place, whereby the period in the course of which deposits of the Maikop

series were laid down on the Kerch Peninsula was the period of epeirogenic movements. The Chokrak age is characterized by subsidence and transgression; the close of the Sarmatian — by uplift and regression. The movements attain their maximum on the boundary between the Sarmatian and Maeotic.

During Lower Maeotic subsidences are observed, while at the close of the Miocene again some parts of the continent, emerge (regression of the sea to the north of the Main Ridge).

At the beginning of the Pliocene uplifts are replaced by subsidence. Later on movements take place on the boundary of the Lower and Middle divisions of the Pliocene; on the boundary of the Middle and Upper divisions of the Pliocene up to the deposition of the „Taman beds" and finally on the boundary of the Pliocene and Post-Pliocene.

The beginning of the Quaternary period was marked by strong reoccurring epeirogenic uplifts and by a weak plicative folding. These movements are made evident by the occurrence on different levels of ancient marine Quaternary deposits and by the tectonics of the Pliocene in the Steppe Crimea.

Tectonic zones. From the point of view of tectonics there are to be pointed out the Main Ridge of the Crimean Mountains (the First Ridge), monoclynal crests (the Second and Third Ridges), the Steppe Crimea and Kerch Peninsula.

In the Mountainous Crimea the Main Ridge is an ancient Mesozoic structure characterized by its great complexity and disharmonic folding. The Triassic and Liassic shales and sandstones are the most strongly dislocated rocks, being crumpled into small folds and sometimes very much crushed. The Middle Jurassic deposits are also folded but they are not so strongly dislocated as the above mentioned rocks. The Upper Jurassic strata are lifted into very gentle folds (Mountainous Crimea — south-western part) or into very steep folds (same locality — north-eastern part).

The Upper Jurassic limestones and conglomerates are torn off from the underlying Triassic and Lower and Middle Jurassic shales. The formation of the Mountainous Crimea took place in two main phases: 1) the ancient Mesozoic phase (antedating the Hauterivian), when the mountain crest was formed; this crest underwent intense erosion on the boundary of the

Jurassic and Cretaceous periods; 2) the late Tertiary and Quaternary phase in the course of which an intense destruction of the ancient mountain structure took place owing to its transverse and longitudinal fracturing, its breaking into separate blocks and thrusting in horizontal direction. At the close of the Tertiary and at the beginning of the Quaternary period in the Mountainous Crimea, a vertical uplift took place accompanied by fractures, faults and subsidence of its southern edge.

The Paleogene and Cretaceous rocks, constituting the monoclynal crests (the Second and Third Ridges) and resting on the abraded surface of the ancient Mesozoic structure show a dip of but 8—10° to NW and N and are not subject to any great disturbances. In north-eastern Crimea only they are broken by transverse faults. On the summit of the Third Ridge the Neogene rocks rest unconformably on the Paleogene and dip northward at an angle of 2—3°.

The Neogene rocks of the Third Ridge form the southern wing of a vast depression known as the Black-Sea depression. This depression not only embraces the Steppe Crimea but also a part of the Ukraine up to the southern slope of the Azov-Podolsk crystalline massif. By a zone of uplifted Neogene rocks (Eupatoria plateau) the above mentioned depression is parted into two isolated zones of subsidence: the Perekop depression in the north and Alma and Azov depressions in the south. Between town Simferopol and Zuya the two last depressions are separated by a vast meridional zone of uplift (Simferopol uplift).

This tectonics of the Steppe Crimea is prominently shown in the character of the shore line of the peninsula, being an evidence of its young age. The Tarkhankut Peninsula made up of Neogene rocks, presents a kind of a vast anticlinal uplift, complicated by four zones of minor, gentler anticlinal folds of latitudinal direction, broken by faults.

The Kerch Peninsula built up of Neogene and Paleogene rocks is characterized by a young Tertiary folded structure.

By the zone of outcrops of Mediterranean rocks forming the arcuate Parpach Crest, the peninsula is divided into the south-western lowland part (the South-Western Plain) and the north-eastern mountainous part.

In the region of the South-Western Plain Oligocene clays play a predominant part, forming anticlines and synclines which are almost not revealed in the relief of the plain. The tectonics of this region, in which Quaternary deposits are widely developed, is but little known to us as yet.

The north-eastern part of the Kerch Peninsula is chiefly formed of Miocene and Pliocene rocks crumpled into numerous brachyanticlines and brachysynclines that are sharply pronounced in the surface relief. In the north-eastern part of the peninsula the folds have a nearly east-western strike and are continued on the other side of the Kerch Strait, in the Taman Peninsula.

The Crimea and the Caucasus arose from a geosyncline, which has been extending along the border of the Russian Platform.

According to the conception of some geologists this geosyncline had no outlet, its closure having lain at some distance west of the Crimea; but other (Russian) geologists are of the opinion that this geosyncline was connected with the West-European sea.

E. Suess pointed out the connection during the Mesozoic of the Mountainous Crimea with Dobrudja (the Cimmerian mountains). The existence of these mountains was put on doubt, yet some geologists admit that at the middle of the Mesozoic there was a connection between the Mountainous Crimea and Dobrudja, and do not see any essential difference in the history of development of both these regions, at least as concerns the close of the Triassic, the Jurassic and the outset of the Cretaceous periods.

The Kerch Peninsula may be regarded as the east, subsided part of the zone of the Crimean mountains. The history of the Kerch Peninsula is different from that of the Crimean mountains. These latter did not suffer any considerable subsidence in Tertiary limes, but were fractured and broken up into separate blocks, most intricately dislocated. As to the region of the Kerch Peninsula, it has been extremely plastic in Tertiary times, due to which it was first strongly depressed, and then subjected to intense folding movements.

As mentioned above, the folds of the Kerch Peninsula are continued into those of the Taman Peninsula. The grouping

of the folds of the Kerch and Taman peninsulas is believed to stand in connection with the region of subsidence of two dislocation systems, i. e. the Crimean and the Caucasian ones.

The folds of the Kerch Peninsula form the region of subsidence of the Crimean mountains. The Taman folds form the further, north-eastern continuation of the gradually vanishing folds of the Kerch Peninsula, controlled by the Caucasian system.

A supposition is advanced, as to the existence of a Transcaucasus-Tauric shield, the Mountainous Crimea being compared with the Rion shield, which is contrasted with the Main Caucasus Range. The geosyncline of the Main Caucasus Range might have had its natural closure in the north-western part of this range. But some geologists are also wholly admitting the possibility of a continuation of the geosynclinal depression of the Main Caucasus Range into the region of the Crimea.

It appears that as early as in the Jurassic the Crimean mountains which arose from that geosyncline began to take the form of an independent, isolated structure having some peculiarities in the history of its development, distinguishing it from the adjacent Caucasus Range.

In the Crimea distinctly perceptible earthquakes seldom occur and only by instruments it is possible to establish here rather frequent insignificant shocks. Only the earthquake of 1927 surpassed in force all those previously known and destroyed many buildings. The Crimean earthquakes start from epicentres located on the meridian of Gursuf, on depths exceeding 1000 m.

In the northern part of the Peninsula, on the Isthmus of Perekop the force of gravity is near to the normal. Further south and south-eastward the force of gravity increases first slowly but afterwards at a rapid rate. The positive anomaly reaches its maximum on the mountain tops. Observations at sea made evident a rapid decline of gravity. In the sea, 25 km. from Alushta, it is negative. Towards the centre of the Black Sea gravity increases and in places attains the normal value. The Kerch Peninsula, in its northern part, represents the continuation of the Kuban gravity depression.

In respect to hydrogeology the Crimean Peninsula falls into the same three major regions: 1) Mountainous Crimea. On the area of the Main Ridge karst waters, feeding all the main rivers of the Crimea, play a great rôle; on the area of monoclynal crests built up of Cretaceous and Paleogene rocks, the waters are confined to separate horizons of the Cretaceous and Paleogene. 2) The Steppe Crimea. Here the main rôle belongs to artesian waters which circulate in different horizons of the Neogene. 3) The Kerch Peninsula. The waters are confined here to separate synclines of Neogene rocks.

The main mineral products of the Mountainous Crimea are represented by various structural materials: igneous rocks, sandstones and limestones. The beautiful grey, pinkish, reddish marmorized Upper Jurassic limestones are known under the name of the Crimean marble which has a wide aplliance as ornamental stone. Of very good quality is the Danian limestone of Inkerman, known as the „Inkerman Stone". Cement marls are widely distributed in the region of the first longitudinal valley (Upper-Eocene marls of Bakhchisarai) and in the region of Theodosia (Lower and Upper Cretaceous marls). On Mount Karadagh 20 km south-west of town Theodosia trass quarrying is under way; the latter is used by the Novorossissk State Cement Works as a hydraulic admixture.

On the area of the Second Ridge „Kil or Kefekelite"[1] ($MgAl_2\ Si_5\ O_{14}\ 6.5\ H_2O$) is distributed, representing a product which from remote times has been used in the Crimea in the quality of fuller's clay in leather industry for the extraction of fat and as a substitute, for soap. „Kil" occurs in thin partings (0.5—0.8 m) on the boundary of the Coniacian and Santonian stages.

Coal occurring in the Middle Jurassic (Beshui deposit), in the head parts of the Kacha river, is of low quality and is only available in small reserves. Ores associated with magmatic rocks are encountered in the form of rare minerals (sphalerite, galenite — Mount Aiu-dagh, and Totaykoy eruptive). In the Upper Jurassic deposits small lenses of psilomelane are met with.

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[1] Keffer Kil, Kiefer Kil.

In the Steppe Crimea the main mineral products are building stone and salts.

On the building stones Maeotic and Pontian limestones consisting of shell detritus are quarried in great quantities. Vast quarries are located in the Eupatoria and Simferopol regions. These rocks serve as a material for the construction of most of the houses not only in the Steppe Crimea but also in other parts of the Crimea.

Salt is extracted in the Steppe Crimea, as on the Kerch Peninsula, from salt lakes.

The saline lakes and „sivashs" (lagoons) of the Crimea fall into six groups, by their geographic distribution: the Perekop, Chonchar-Arabat, Eupatoria, Kherson and Kerch groups.

The formation of the salt lakes and „sivashs" stands in direct dependence on the oscillatory epeirogenetic subsidences of the North-Azov — Black-Sea Coast in Quaternary time. On the floor of the salt lakes occur mighty accumulations of muds, some of which are used for medicinal purposes.

Extracted from the Crimean lakes are common salt, Glauber's salt, magnesium sulphate, magnium chloride, potassium salts, bromine, medicinal muds.

The most renowned for its richness in salt and its medicinal muds is the group of Eupatoria lakes. At the Sasyk-Sivash and Saki lakes of that group are concentrated the salt and chemical industries of the Crimea. The Saki and Moinak lakes are the main medicinal centers of treatment by mineral muds. The salt reserves of the lakes are considerable; thus the salt reserves of Sasyk-Sivash are up to 4 733 800 tons.

Salt is also extracted from the lakes of the Chongar-Arabat group, and others.

The main mineral products of the Kerch Peninsula are as follows: iron ores, also building stone and finally sulphur, gypsum, borax, asphalt, oil, hydrocarbon gases and salts.

The iron-ore deposits of the Kerch Peninsula are distributed along the coasts of the Kerch Strait and of the Azov Sea.

The ore beds are confined to the Pliocene (Cimmerian stage) and present typical sedimentary iron ores. The ore is a brown iron ore of oolitic structure, distinguished by highly variable texture, mechanical and mineral composition. The

ores are either loose or cemented. The average content of Fe is 33—40%; of manganese — 1—2% and even up to 11%; of Si — 15—22%; P — 0.7—0.8%; S — 0.04%.

Besides the above enumerated elements the ores contain arsenic, vanadium, aluminium, calcium, barite, sodium, and organic matter.

The ore beds occur in synclines which trend latitudinally in the northern part of the Kerch Peninsula and north-eastwardly in its eastern part. The deposition of the ore beds took place in rather small and shallow basins.

The reserves of the ores of the Kerch Peninsula estimating in 1928 at 1000 mill. tons at present in result of prospecting works they are estimated up to 2725.9 mill. tons.

For the recovery of the ores the large Kamysh-Burun Combined Iron-Ore Conditioning Plant has been erected.

Native sulphur is mined from the Mediterranean beds (Chokurkoiash deposit). Its reserves are insignificant. Borax is present in the salt waters of the mud volcanoes of Bulganak and Tarkhan. Oil is confined to the Maikop series and to the Mediterranean rocks. Insignificant asphalt deposits are present near town Yeni-kalé and at other points. From many mud volcanoes and especially from bore-wells combustible gases are escaping, mainly methane.

The mineral waters of the Crimea belong to several types, viz.: sulphur-saline, alkaline-earth, saline-alkaline, boracic, sulphate-sulphurated; besides that, iodine and bromine waters are distributed. The mineral springs are most widely distributed on the Kerch Peninsula.

ITINERARY OF THE GEOLOGICAL EXCURSION IN THE CRIMEA

The first day in the morning the participants of the geological excursion arrive in the Crimea at town Simferopol. From there they go to Yalta via Alushta. The following (second)

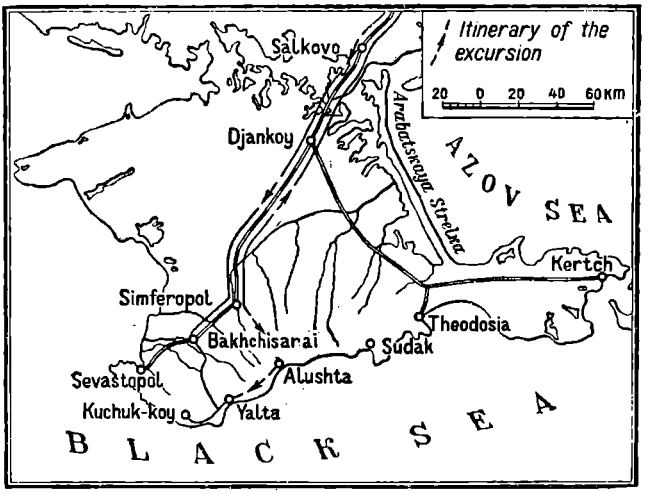

Fig. 1. Schematic Map of the Itinerary of the Excursion in the Crimean ASSR.

day they get acquainted with the Southern Coast (Livadia, Alupka, Kuchuk-koy) and on the third day via Ai-Petri, Kokkoz village and town Bakhchisarai they leave the Crimea.

The aim of the excursion is to study the stratigraphy and tectonics of the Mesozoic deposits in the Crimea.

FROM SIVASH TO SIMFEROPOL

By *A. MOISSEIEV*

Salkovo is the last station of the southern railroads situated on the mainland. Further on the railroad runs over the isthmus of the Chongar Peninsula, built up of Quaternary loams, passes by Chongar Station and Slvash Station, crosses the water body of the Sivash and reaches the territory of the Crimea (Taganash Station). En route the dissected coast of the Sivash can be seen, made up of brown Quaternary loams. From Taganash Station to Djankoy Station and southward from the latter to Kurman-Kemelchi Station spreads a level steppe built up of Quaternary loams. The latter are underlain by Neogene rocks. Between the Kurman-Kemelchi and Sarabuz stations, the Crimean mountains can be distinctly seen in the south. Between Sarabuz station and Simferopol the steppe acquires the character of a rolling plain.

At Sarabuz station the railroad crosses the Salghir River, runs past Karakiyat station and crosses once more the Salghir River at the very station of Simferopol.

FROM SIMFEROPOL TO YALTA

By *A. MOISSEIEV*

Simferopol (44°56′ N. latitude, 34°06′ E. longitude; 220—280 m above sea level, 50 km of Alushta and 95 km of Yalta) is the cultural and administrative centre of the Crimean ASSR and is situated on the northern slope of the Second Ridge of the Crimean Mountains. From Simferopol to Bakhchisarai the railroad runs along a longitudinal valley separating the Second Ridge from the Third, the latter being clearly visible north-eastward of Simferopol. The Salghir River flows through this town. At the south-eastern outskirts of the town is situated the ancient Neapolis — the capital of Skilur, tsar of Scythians, in the and century B. C.

By crossing of the Third and Second Ridges along the valley of the Salghir River the following section has been established.

1. Quaternary deposits and Upper Pliocene. On the summit of the Third Ridge there are at places encountered eroded continental Quaternary and Upper Pliocene red clays and pebble beds; thickness . . . . . 1—2 m.
2. Middle Sarmatian. Limestones with casts of *Cardium fittoni* d'Orb., *Mactra podolica* Eichw., and other ill-preserved fauna; thickness . . . . . 5 „
3. Lower Sarmatian. Clays and sands; thickness . . . . . 3 „
4. Mediterranean. (Chokrak and Karagan beds). Quartz sands, clays, limestones swarming with *Spaniodontella* shells; thickness . . . . . 5 „

Sarmatian and Mediterranean rocks constitute the summit of the Third Ridge and form at places at its border abrupt cornices. Rocks of this age dip gently to NW 2—3° and rest on the eroded surface of the lower seated deposits.

5. Upper Eocene. White marls with interbeds of sandy marls containing fish scales (*Lyrolepis caucasica* Roman); thickness . . . . . 300 m
6. Middle Eocene. Nummulitic limestones grading downward into nummulitic marl. The limestones (Lutetian stage) contain *Nummulites distans* Desh., *N. tchihatchevi* d'Arch., etc., echinoids, gastropods, pelecypods; the marls, with fine *Foraminifera* include *Nummulites atacicus* Leym., *Discocyclina* aff. *sella* d'Arch., *Assilina mamillata* d'Arch. The Eocene rocks dip 8—10° to NW and form the Second Ridge; thickness . . . . . 30 .

The southern part of town Simpferopol lies on the nummulitic limestones. The Eocene deposits rest transgressively in the valley of Salghir River, possibly on the Albian of Cenomanian, which are concealed by landslips: then, south-westward of town Simferopol, on different horizons of the Upper Cretaceous, and further on the Paleocene rocks (valley of the Alma River). The nummulitic limestones yield easily to weathering, forming pillars and undercut caves („abris"), north-eastward of town Simferopol at Chokurcha village these limestones form a grotto containing remains of Paleolithic culture of man (Mousterian). Here are found flint implements and bones of the mammoth, rhinoceros, etc.

Proceeding from town Simferopol along the high road still within the town boundary the nummulitic limestones are crossed; on leaving the town (Petrovskoie — Podgorodneie villages) the region of development of the Lower Cretaceous is reached, which along the road extends to south-east up to Marianovka village.

1. Aptian. Clays with *Neohibolithes semicanaliculatus* Bl., *Mesohibolithes minaret* Rsp.; thickness . . . . . 6—12 m
2. Barremian. Reddish argillaceous limestones with ferruginous oolites and a rich fauna of brachiopods, pelecypods, ammonites, echinoids, etc.: *Cidaris lardyi* Des., *Dorocidaris pyrenaica* Cott., *Magnosia camarensis* Web., *Codechinnus rotun-*

dus Des., *Zeilleria hippopa* Roem., *Z. tamarinda* Sow., *Rhynchonella eichwaldi* Kar., *Barremites difficile* d'Orb., *Astieria* cf. *cadoceroides* Kar.; thickness . . . . . 1—2 m

3. Hauterivian. Yellowish limestones with argillaceous-arenaceous partings including a rich fauna: *Chlamys goldfussi* Desh., *Neithea atava* d'Orb., *Alectryonia rectangularis* Roem., *Exogyra subsinuata* Leym., *Exogyra minos* Cocq., *Nautilus neocomiensis* d'Orb., *Panopaea gurguitis* Brongn., *Lyra neocomiensis* d'Orb., *Spondylus roemeri* Desh., *Holectypus macropygus* Des., sponges, corals, *Serpula*; thickness . . . . . 1—2 „

The Lower Cretaceous dipping NW ∠ 12—15°, lies transgressively on the eroded surface of the Middle Jurassic conglomerates which along the road appear at places from under the Lower Cretaceous. The Middle Jurassic is at places overlain by the Hauterivian and at places by the Barremian. The Aptian clays near Marianovka village are exploited for the manufacture of bricks. Landslides occur along the abrupt border of the nummulitic limestones, slipping along the surface of the Aptian clays. Westward of Marianovka village from under the nummulitic limestones crop out white Senonian marls in the lower parts of which lies a bed of „kil" which is worked.

In the valley of the Salghir River, between Simferopol and Eski-Orda village, from under the Lower Cretaceous rocks crop out strongly dislocated Middle and Lower Jurassic, Triassic and Lower Permian rocks which form the backbone of the „Mesotauric crest" of K. Vogt, built up, according to the conception of the latter mainly of Paleozoic or Lower Triassic rocks. However more recent investigations made evident that the Paleozoic deposits (Lower Permian) play an insignificant role in the structure of the region: the conglomerates considered by K. K. Vogt to be Permian or Lower Triassic in reality proved to be of Middle Jurassic age.

The Lower Permian is represented by grey limestones with rare trilobites, ammonoids and fusulinids. The limestones occur in the form of insignificant blocks (up to 150 m in diameter). One of them lies on the right bank of the Salghir River: another is opposite Marianovka village (can be seen from the high road); and one is on the summit of a hill above the high road to the west of Eski-Orda village; and finally small

blocks are encountered to the north of the Totaykoy eruptive massif.

The Lower Permian limestones apparently represent reefs which were already eroded at the beginning of the Mesozoic era. These reefs were involved in the Mesozoic and Tertiary movements. They occur amidst strongly crushed shales and sandstones of Triassic and Liassic age. It is noteworthy that the Liassic conglomerates rather often include pebbles of Lower Permian limestones.

In the valley of the Salghir River the following summarized section of the Liassic and Upper Triassic has been established.

1. Lias. Micaceous sandy shales deprived of fauna. They either have a thickness of several tens of meters or are totally absent.
2. Limestones swarming with crinoids and containing numerous brachiopods: *Spiriferina alpina* Opp., *Sp. walcotti* Sow., *Sp. haueri* Suess, *Terebratula punctata* Sow., *Zeilleria subnumismalis* E. Desl., *Salgirella* (*Rhynchonella*) *alberti* Opp., *Rhynchonella curviceps* Qu., etc., *Arietites* ex gr. *raricostatus* (Lower-Lias). Thickness . . . . . 1—3 m
3. Rhaet-Lias. Quartzose sandstones and conglomerates with a pebble composed of quartz and sandstone; the plant remains enclosed in the latter are: *Filicales*, *Dioonites*., *Ptilozamites*., *Carpolithus*. Thickness . . . . . 150 „
4. Rhaet-Norian. Reddish limestones with *Pseudomonotis caucasica* With., *Spirigera oxycolpos* Emm., *Euxinella* (*Rhynchonella*) *eskiordaensis* Moisseiev, *Rhaetina taurica* Moisseiev, *Zeilleria austriaca* Zug. These limestones occur in the form of blocks in the sandstones of horizon 3.
5. Norian and Carnian. Light-grey and dark micaceous sandstones with *Halobia* aff. *neumayri* Bitt., *Halobia bittneri* Zitt., *Mysidioptera*, *Parcestes*., *Clidonautilus*. Thickness . . . . . 80 „
6. Dark argillaceous shales with *Pseudomonotis caucasica* Witt. Thickness . . . . . 2 „
7. Dark argillaceous shales. Thickness . . . . . 10 „

The Triassic and Liassic rocks are strongly disturbed, i. e. lifted into fine folds and in places crushed into small fragments.

These strongly crushed rocks are overlain by a thick series of coarser conglomerates and sandstones of Middle Jurassic

age (Bitak series) containing a scanty fauna (*Pseudomonotis echinata* Sow., *Posidonia buchi* Roem) and plant remains represented by *Elatides* ex gr. *curvifolia* Nath., *Williamsonia pecten* Phill., *Nillsonia* sp., *Cladophlebis denticulata* Brongn. The pebble of the conglomerates consists of quartz, sandstone, metamorphic schists (phyllites) and magmatic rocks. The thickness of the conglomerates is not under 1000 m. Fine exposures of the conglomerates are present on the right and left banks of the Salghir River between Bitak village and the Djien-Sofu farm.

The Liasso-Triassic shales are traversed by diabase and porphyrite. A considerable outcrop of diabase is encountered near Totaykoy where its contact with Triassic shales can be observed. Here a lode with galenite and nacrite is exposed in a quarry. Hear Salghirchik farm above and below the highroad the diabase lies in contact with Liassic limestone and quartz sandstone.

In the valley of the Salghir River the attitude of the above rocks under examination is as follows (from NW to SE): conglomerates of Middle Jurassic age (Bitak series) stand almost on end and strike NE 60°, then follow much crumbled and crushed Triassic and Liassic rocks, with blocks of Lower Permian limestones. In places the imbricated structure of this series is readily distinguishable: the series is broken by transverse faults, the direction of which more or less coincides with the direction of the Salghir River; owing to lack of good exposures difficulties arise if a detailed description is attempted of the attitude of rocks in the above mentioned valley of the Salghir River.

In the region under review, on the right and left banks of the Salghir River, a river terrace is observed, on a height of 8—10 m above the modern bed of the stream. In the head parts of the Salghir River this terrace gradually rises and is located on a height of about 20—25 m above the river-bed.

The excursion going to the valley of the Salghir River on leaving Simferopol will pass along the right bank of the Salghir River through Bitak village where can be observed the superposition of the Eocene upon the Cretaceous and the attitude of the Hauterivian and Barremian resting transgressively upon the Middle Jurassic. Afterwards the excursionists will

study the Lower Permian deposits of Djien-Sofu and northward of the Totaykoy eruptive. Here also they will inspect the Upper Triassic deposits and the diabase quarry, and then, at Salghirchik farm they will return to the highroad of Alushta.

Between Salghirchik farm and Kilburun village the valley of the Salghir River becomes narrower and its steep slopes are formed by a thick (200 m) series of coarse conglomerates and sandstones, resting on the abraded surface of the Triassic and Liassic rocks. On Mount Bairakly (right bank of the Salghir River) these conglomerates have been found to pass up into sandstones and limestones of Hauterivian age: farther south, near Tereskunda village (Mount Kosh-Kai) the conglomerates rest on the eroded surface of Kimeridgian and Lower Tithonian limestones, which are underlain by Lusitanian conglomerates and Tauric shales. The conglomerates and sandstones of Mount Bairakly are unfossiliferous but their stratigraphical position indicates a Valanginian and possibly Upper Tithonian age. Near Kilburun the conglomerates under examination are broken by a fault; in the south they lie in contact with sandstones and clays of Albian age. In a south-eastward direction of Kilburun village the valley of the Salghir River expands and between this village and Mamut-Sultan village the road fol-

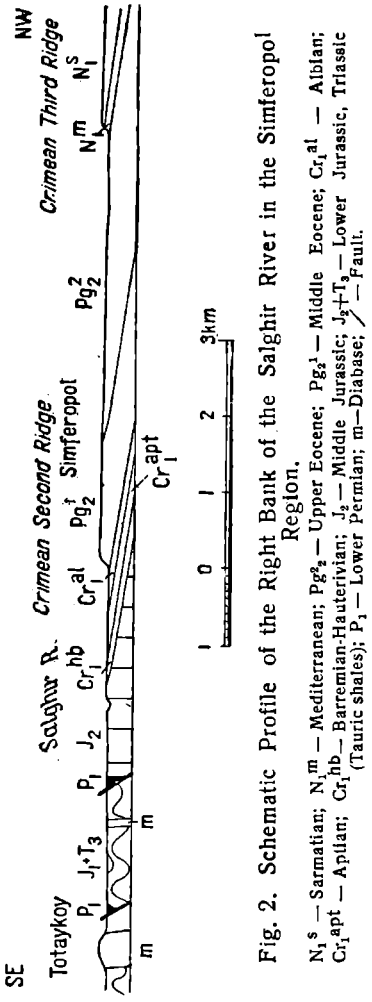

Fig. 2. Schematic Profile of the Right Bank of the Salghir River in the Simferopol Region.

N_1^s — Sarmatian; N_1^m — Mediterranean; Pg_2^2 — Upper Eocene; Pg_2^1 — Middle Eocene; Cr_1^{al} — Albian; Cr_1^{apt} — Aptian; Cr_1^{hb} — Barremian-Hauterivian; J_2 — Middle Jurassic; J_2+T_3 — Lower Jurassic, Triassic (Tauric shales); P_1 — Lower Permian; m—Diabase; / — Fault.

lows a high river terrace. From this terrace a view is obtained to the east and north-east on the Dolgorukov Yaila Mountains, formed of Kimeridgian and Tithonian reddish limestones from below of which at places appear conglomerates of apparently Lusitanian age (Bura village) which are overlain between Bura and Terenair villages, by Valanginian, Hauterivian and Barremian sandstones, marls and limestones. In the south can be observed the Demerdji Yaila Mountains made up of Upper Jurassic rocks. From Mount Chatyr-dagh, formed also of Upper Jurassic rocks, these mountains are separated by a gorge (canyon) in which the Angara River is flowing. Towards the west the divide between the Salghir and Alma rivers is made of the above described Bairakly conglomerates. The floor of the Salghir valley in its southern part, is filled by Aptian clays containing *Neohibolithes semicanaliculatus* Bl. and ammonites (*Desheyesites descheyesi* Leym.), which are distributed in the south-eastern part of the valley, in the region of Eni-Sala village, and then by Albian clays with *Hibolithes minimus* List. interbedded with sandstones.

Well displayed are exposures of Albian sandstones in the right bank of the Salghir River, near Eski-Sarai village; in the same bank, in the region of the Shumkhai village an alternation of clays with sandstones is observed. In the headparts of the Salghir River the thickness of Cretaceous deposits which are broken by faults, is very great, being estimated at several hundreds of meters.

The upper part of the Salghir valley is a vast graben bounded on all sides by faults. Easily traceable are the fault along the southern slope of Mount Bairakly and the system of complex pinnate fractures along the western border of the Dolgorukov Yaila Ridge. In the south the Uppe Jurassic of the Demerdji Yaila Ridge and Mount Chatyr-dagh are slightly thrust upon the Aptian clays of the Salghir valley, which are traceable for a long distance in the narrow canyon between the Demerdji Yaila Ridge and Mount Chatyr-dagh. Well observed can be the overtrust of the Upper Jurassic upon the Lower Cretaceous near Ayan village at the very source of the Salghir River which issues in the form of a spring of the „vocluse" type from the Upper Jurassic limestones.

Passing Mamut and Shumkhai villages and then Angara vil-

lage, the road runs along the above described canyon located between Mount Chatyr-dagh and the Demerdji Yaila Ridge. To the north of the Angara village in Upper Jurassic limestones lies a cave Kizil Khoba with a subterranean stream. At the cave entrance is present a vast accumulation of calcareous tuff with imprints of modern plants; at this same place was detected a Paleolithic stand and of the man of the Bronze Age. The highest summit of the Chatyr-dagh is Mount Eklizi-Burun located at its south-eastern border (1523 m above sea level). Mount Chatyr-dagh displays the following structure: at the base occur the Tauric shales of Liasso-Triassic age; on their abraded surface rest coarse conglomerates and sandstones of Lusitanian age (thickness — 150 m), higher follow grey, stratified Lusitanian limestones with corals, echinoids, sponges, and brachiopods (thickness — 250 m), these deposits grade into grey Kimeridgian limestones containing large *Dicyclina lusitanica* Egger (thickness — 200 m) succeeded by grey Tithonian limestones (thickness — 250 m) with a varied fauna of gastropods. On the southern slope of Mount Chatyr-dagh the Upper Jurassic is characterized by thin-bedded and compact grey limestones, whereas on its northern slope are developed compact reddish limestones, containing *Rhynchonella astieriana* d'Orb., *Terebratula moravica* Suess, etc. In some places these limestones are overlain by Hauterivian clays and marls with belemnites.

In the southern part of Mount Chatyr-dagh the Upper Jurassic strata dip 35° to NW, abut directly against the Tauric shales and are displaced along them. Along the northern edge of the main summit runs a fracture and further on the limestones dip NW ∠ 20°, and in the northern part — SE ∠ 40°. Here the Upper Jurassic deposits form a syncline, much complicated by fractures. In the core of the syncline — in the head parts of the Salghir River — the Lower Cretaceous deposits are squeezed. At the Ayan village, along the northern slope of Mount Chatyr-dagh runs a fault and, as it is mentioned above, the conglomerates and limestones are thrust upon the Lower Cretaceous deposits.

On Mount. Chatyr-dagh, which is characterized by its karst topography, are present vast stalactite caves (Binbash-Khoba, Suuk-Khoba); in one of these caves were found stands of the

Paleolithic man and rests of an extinct Quaternary fauna. Both the summit of Mount Chatyr-dagh and the summit fo the Crimean Yaila represent an ancient denudation surface, the formation of which is referred to the Tertiary period.

In the narrow canyon between Mount Chatyr-dagh and Demerdji (valley of the Angara River) the Lower Cretaceous clays almost reach to Kurliuk River. Before this river is reached in an artificial section by the road, clays with sandstone partings are visible, while some distance farther south coarse conglomerates with pebble consisting of sandstone and igneous rocks and huge blocks of Upper Jurassic limestone make their

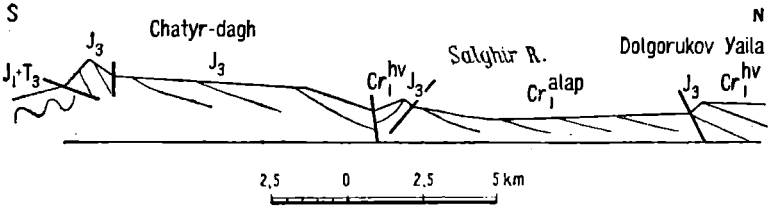

Fig. 3. Schematic Profile across Mt Chatyr-dagh and the Salghir River Valley.

Cr_1^{alap} — Albian-Aptian; Cr_1^{hv} — Hauterivian-Valanginian; J_3 — Upper Jurassic, $J_1 + T_3$ — Tauric shales; / Fault.

appearance. These Kimeridgian conglomerates overlie the grey Jurassic, Lusitanian limestones which are exposed in the very channel of the Angara River. Some distance upstream of the farmstead Kurliuk, in the left bank of the river, from below the Lusitanian limestones crop out red Lusitanian conglomerates with pebbles composed of quartz, sandstone and shale, and from below these deposits, — the Tauric shales (Upper Triassic-Liassic). Further to the south, up to the Angara Bogaz Pass, the Tauric shales are developed at the base of the Upper Jurassic deposits. At places (Farm Taushan Bazar), the Tauric shales are much crumpled into small folds and are crushed. At this place, as well, are encountered fragments of crumbled Upper Jurassic red conglomerates. The direction of the canyon along which the road was laid coincides with the fracture by which Mount Chatyr-dagh was separated from the Demerdji Ridge. From the Angara Pass (762 m) to the east

a view is obtained of the Demerdji Yaila Range and Mount Demerdji, and to the west of the southern slope of Mount Chatyr-dagh. On the southern slope of Mount Chatyr-dagh can be observed a gradual detachment along fissures of Upper Jurassic limestones and their violent slumping and sliding along the shales. This enormous landslide is traceable as far as Shuma village. Following the road from the pass to Alushta, at places can be observed the Tauric shales, which are here exceedingly crumpled into small folds and often are disrupted or crushed.

The Demerdji Yaila Range represents a very gentle syncline formed of Lusitanian conglomerates; the conglomerates pass upwards into Kimeridgian limestones which include conglomerate partings. In the south these rocks are separated from the Upper Jurassic conglomerates of Mount Demerdji by a fault. Along the line of fault the Tauric shales are squeezed out upon the thick series of conglomerates constituting Mount Demerdji. The conglomerates and sandstones of Mount Demerdji enclosing rare limestone lenses and interbeds fall into two horizons; the conglomerates of the lower horizon contain pebbles of sandstones, crystalline rocks and shales (Lusitanian stage); whereas in the upper horizon there are also present pebbles and blocks of Upper Jurassic limestone as well as limestone interbeds (Kimeridgian). The rocks of Mount Demerdji, dipping NW, are displaced along the shales; the conglomerates of that mountain yield easily to weathering and form fantastic pillars. At the southern foot of Mount Demerdji is seen an accumulation of conglomerate blocks slipped from above. This rockfall took place in 1894 and destroyed a part of Demerdji village, which was transferred to another place. The entire slope from Mount Demerdji to the sea is made up of strongly folded Tauric shales, which are eroded and cut by numerous ravines. In places can be observed terraces formed of proluvial and deluvial deposits. Just before reaching Shuma village here is a landslide; beyond the village to the west is the Babugan Yaila Range built up of Upper Jurassic limestones, and the forest clad mountains Chamny-Burun, Uraga and Kastel built up of crystalline rocks. From Mount Chatyr-dagh the Babugan Yaila Range is separated by the Kebit-Bogaz Pass made of Tauric shales.

The high road crosses the vineyards of the State farm „Sadvintrust“ and leads to town Alushta.

Alushta (44°41′ N. latitude and 34°25′ E. longitude, 50 km from Simferopol; 45 km from Yalta) is located in the valleys of the mountain rivers Demerdji (east) and Ulu-Uzen (west).

It is one of the health resorts of the Crimea, has 9 sanatoria and many rest-homes. This town called formerly Aluston arose by the Emperor Justinian who had constructed a fortress there (VI century). In the XIII century, when the southern coast was ruled by the Genoese, Alushta was a large settlement, — here the Genoese consul and the bishop resided. In the Italian documents and maps of the XV, XVI and XVII centuries Alushta is mentioned under the names of Lusta, Lusca. In the centre of the town an ancient tower is preserved.

From Alushta to the east a view is obtained of Mount Demerdji, the Karabi Yaila and the mountains in the environments of Sudak. On clear days cape Meganom is visible.

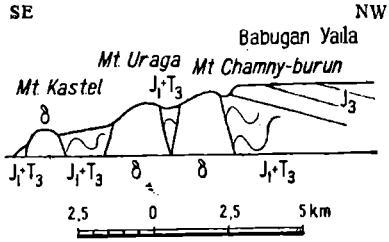

Fig. 4. Schematic Profile of the Southern Coast West of Alushta Town.

J_3 — Upper Jurassic; $J_1 + T_3$ — Tauric shales; δ — Diorite.

The road from Alushta to Yalta ascends among much dislocated shales. Above the sea rises the laccolith of Mount Kastel; this mountain is mainly made up of quartz-augite-diorite and on its southern and eastern slope are developed quartz-pyroxene-porphyry rocks. Higher than the road, above Mount Kastel rises Mount Uraga and on the level of the Babugan Yaila — Mount Chamny-Burun (1212 m above sea level). North eastwards of Mount Chamny-Burun rises Mount Anton Kaya and to the north of the Uraga — the Ai-Yori and Seragoz mountains. The Uraga and Chamny-Burun mountains are formed of coarse-grained quartz-augite-diorite; acid rocks (71 — 58% SiO_2) and those rich in Na_2O, described by Lagorlo under the name of taurites constitute the Ai-Yori and Seragoz mountains. These rocks occupy an intermediate posi-

tion between the keratophyres and pantellerites and represent granophyric or spherolitic soda liparites.

Leaving behind the pass above Mount Kastel the high road leads to the Biuk-Lambat village. Above that village at the foot of the Babugan-Yaila Range are seen enormous landslips due to the downbreak of Upper Jurassic limestones. These same limestones constitute Mount Paragelmen. Very close to the village Biuk-Lambat, above the high road is present an outcrop of diorite (Mount Ai-Todor). Further on, above Kuchuk-koi village there is a rather small laccolith of Mount Sharkha surrounded by highly altered Tauric shales. It is quartz porphyry which is cropping out here. In the region of Degermenkoi village, at the high-road, can be observed Tauric shales, which are highly crumpled into fine folds. From here can be viewed Mount Aiu-dagh and cape Plaka which is made up of quartz porphyrite. In front of cape Plaka rises Mount Biuk-Kaya which is formed of rocks similar to those of Mount Kastel. In the vicinities of cape Plaka is situated the Karasan health-resort. At the sea coast in Partenit which lies eastward of Mount Aiu-dagh extend crests formed of quartz diorite and appears a cape presenting a laccolith formed of quartz porphyry.

By excavations at Partenit, traces of a Gothic town were discovered and also a temple of the VIII century, which existed up to the XVII century. Numerous ruins of ancient buildings are also present on Mount Aiu-dagh (Bear Mountain) and in its vicinities. Near Kurkulet village, by the high road above Mount Aiu-dagh occurs a diorite laccolith. Mount Aiu-dagh is also built up of quartz-diorite; its different varieties can be observed here; on the portion of the Aiu-dagh projecting into the sea are present porphyrites; high along its slope rise Tauric shales which at places are also present on its summit. A fine contact with shales is observed near the western foot of Mount Aiu-dagh on the sea-coast in Artek. Here can be observed apophyses shooting off from the main massif and penetrating the highly crushed Tauric shales; in the zone of contact frequently occurs pyrite, rarer, sphalerite, cadmium blende.

In Artek there is an outcrop of an acid spherolitic granophyre rock (SiO_2, 71%) (taurite of Lagorio). In Artek is sit-

uated the All-Union Pioneer Camp; further westward on the sea-shore are located the health resorts — Suuk-su and Gursuf with parks, rest-homes and sanatoria.

Gursuf is the ancient Gursuvia. On the medieval Italian maps Gursuf is known as Grasui and Gorsanium. The Emperor Justinian erected here in the VI century a fortress. Its ruins are preserved up to now. In the vicinities of Gursuf owing to excavation works, were discovered many Gothic monuments. In Gursuf and above it can be observed huge limestone slips and landslides. In the sea near Gursuf are two small islands (Odolar) built up of Upper Jurassic limestones.

Large slipped blocks of limestones are present in Kizil-Tash village. In the coastal part are developed Tauric shales. At the foot of the Yaila Range crop out from below the landslips of Middle Jurassic sandstones and shales with plant remains. (*Cladophlebis denticulata* Brongn., *Dicthyophyllum rugosum* L. and H., *Brachiphyllum mamillare* Brongn.) and pelecypods (*Posidonia buchi* Roem., *Pseudomonotis echinata* Sow.). Higher occur limestones referred to the Lusitanian and Kimeridgian which constitute the Babugan-Yaila Range in the north and the Nikitskaya Yaila Range in the west. Between these ranges is situated a pass — the Gursuf Saddle (Gurbet-dere-bogaz). Above Gursuf, at the northern border of the Babugan Yaila Range is situated the highest point of the Crimean mountains — Mount Roman Kosh (1543 m). The cape of Nikitski, projecting in the south consists of Upper Jurassic limestones.

From Gursuf the high road runs over strongly crushed Tauric shales, then to the west of Ai-Danil crosses the slipped Middle Jurassic sandstones and reaches Nikita village. Near this village are developed slips of Upper Jurassic limestones. From Nikita village the amphitheatre on which is situated town Yalta can be seen; far off can be distinguished the crenulation of the mounts Ai-Petri and Megabi. Below the village, at the sea coast is situated the Nikita Botanical Garden which is famous for its numerous and varied flora.

From Nikita village to Massandra the road follows the margin of a vast slip of Lusitanian limestones, from below of which at places make their appearance Middle Jurassic sandstones and shales, enclosing coal lenses. Below the high road the Tauric shales are developed. In Massandra, above the

high-road, is situated the former Palace of Alexander III, now transformed into a rest-home and below the road lie vineyards and the park of Massandra. The road leads to the edge of the valley of Guva River in the vicinities of Yalta, where the Ai-Vassil and Derekoi villages are located. Upstream of Ai-Vassil the Guva River flows along the Uch-Kosh gorge, the direction of which coincides with the dislocation of the Lusitanian and Kimeridgian limestones forming the abrupt escarpment of the Yaila mountains. On Mount Balan Kaya on the right bank of the Uch-Kosh Gorge, the Upper Jurassic limestones dipping NW ∠ 30—36° are clearly seen to have an abnormal contact with the Middle Jurassic deposits and to be displaced along them. Further on the road passes over Upper Triassic shales with *Pseudomonotis caucasica* Witt. and reaches town Yalta.

Yalta (44° 30′ N. latitude and 34° 10′ E. longitude, 85 km. from Sevastopol, 95 km from Simferopol and 82.5 km from Bakhchisarai) is a centre of the greatest importance on the Southern Coast, including many medicinal institutions, sanatoria, rest-homes, etc. Yalta, in Greek Yalita was probably founded by the Greeks. The earliest historical data concerning Yalta date from the XI century. On the Italian maps of the XIV century to Yalta are applied the names of Kallita, Giallita, Etalita. Yalta was an important fortified center of the Greeks, Genoese and the Turks. In the environs of Yalta are the splendid parks of Livadia (former residence of the tsar, now a health resort), Oreanda and Massandra. Far known for their beauty in the vicinities of Yalta are the water-fall Uchan-su, Mount Ai-Petri and the „Forestry".

The most ancient rocks in the region of Yalta are the shales referred to the Lower Triassic with *Pseudomonotis caucasica* Witt., *Halobia neumayri* Bitt., etc. Fine exposures of these rocks can be observed in the Sadovaya Street, in Derekoi village, then here occur shales, sandstones and conglomerates referred to the Lias, grading into dark limestones exhaling a fetid odour when struck, swarming with segments of crinoid stems and including brachiopods (Lower-Middle Lias), *Spiriferina walcotti* Sow., *Sp. alpina* Opp., *Sp. yaltaensis* Moisseiev, *Sp. haueri* Suess, *Rhynchonella variabilis* Dav., *Rh. curviceps* Qu., *Zeilleria subnumismalis* E. Desl., *Tere-*

bratula punctata Sow., etc. The sandstones and limestones occur in the form of isolated blocks in crushed shales (Ai-Vassil, the former Quarry Getmanovskaya, street of Dostoevski, Livadia). Among the pebbles of Liassic conglomerates are encountered Lower Permian limestones with fusulinids.

The Triassic and Liassic deposits, which are much crushed and crumpled into fine folds, are overlain by Middle Jurassic sandstones sometimes containing *Pseudomonotis echinata* Sow., *Cladophlebis denticulata* Brongn., *Dictyophyllum*, etc. and thin lenses of coal; the contact with the underlying deposits is abnormal everywhere. The sandstones pass upwards into argillaceous and fine-grained sandstones of Bajocian and Bathonian ages. The shales include argillaceous nodules with pelecypods and ammonites (*Posidonia buchi* Roem., *Oppella fusca* Qu.); the sandstones often yield plant remains *(Williamsonia pecten)*. The Upper Jurassic deposits are represented by compact and bedded limestones (Rauracien) with sponges, corals and echinoids. The Upper horizons include partings of conglomerates with calcareous pebble and cement. These rocks pass upwards into marls, argillaceous-calcareous sandstones and sandy limestones with a very rich fauna of corals and gastropods (*Nerinea ursicinensis* Th., *N. sculpta* Et., *Sequania lorioli* Cossm., *Mytilus furcatus* Münst., *Cardium apicilabratum* Et., *Lima corallina* Th.; *Rhynchonella corallina* Leym.).

Higher follows a thick series of Lusitanian grey compact and thin-bedded limestones with corals, sponges, echinoids and brachiopods. This series grades imperceptibly into the Kimeridgian limestones with *Dyciclina lusitanica* Shoff., *Perisphinctes*, *Haploceras erato* d'Orb. The Lusitanian and Kimeridgian limestones form the entire southern escarpment of the Yaila Mountains.

Among the Tauric shales are enclosed diorites (town Yalta, the former Quarry Getmanovskaya) and keratophyres (Issar high road). The Middle Jurassic shales (by the high road, 2 km beyond Uchan-su) are cut by augite porphyrite.

FROM YALTA TO SEVASTOPOL

By *V. PCELINCEV*

On leaving Yalta the high-road ascends the slopes of the Chainyi (Tea) Range, crowned by Mount Megabi. Here the following full succession of strata has been established: Triassic shales, Liassic limestones and conglomerates (Tauric formation) and Middle Jurassic shales and sandstones, overlain by Lusitanian conglomerates and limestones of Mount Megabi.

On the sea coast are located in succession: Chukurlar, a suburb of Yalta, lying on an active landslide; Livadia, the former estate of the tsar, with its palace transformed after the Great October Socialist Revolution to a peasants' health-resort of All-Union importance; and Oreanda. At this place the high-road divides into two parts. The lower road descends in zigzags through the vineyards of Oreanda to the seacoast at „Zolotoi Pliazh" (Golden Beach), a health resort for consumptive-children.

On this tract the lower high-road runs within the limits of the ancient landslide of Oreanda, preserving traces of activity. In the upper part of the broad landslide cirque lie such large detached limestone massifs, as for instance, Mount Ai-Nikola and others. A part of the detached massifs in their slow, continuous seaward movement has crept very low down the slope, as can be observed on the Machtovaya and Krestovaya cliffs in Oreanda. Beyond the sanatorium, of Kichkiné (a Tartar word meaning „small") the high-road approaches the Ai-Todor cape with its lighthouse. Near the lighthouse are

located the ruins of the ancient Roman fortress Kharaks; here excavation works were performed, giving rich results; here also stands the villa „Lastochkino Gniezdo“ [1] situated most beautifully on the steep bluff of the sea-coast.

Cape Ai-Todor is built up of Lusitanian limestones, which in result of tectonical displacements were pushed forward into the sea. Besides, these limestones move independently down the slope, along the surface of the shale- and sandstone series, and at the same time break into a number of large blocks. Owing to this the Ai-Todor Range represents a gigantic staircase, consisting of huge steps sloping backwards.

The limestones contain a rich fauna of corals and thick-walled mollusks from which ought to be mentioned: *Sequania lorioli* Cossm., *Nerinea ursicinensis* Thurm., *Nerinea sculpta* Etall., *Nerinea contorta* Buv., *Nerinella cynthia* d'Orb., *Nerinella canaliculata* d'Orb., *Polyptyxis cassiope* d'Orb., *Ptygmatis clio* d'Orb., *Ptygmatis pseudobruntrutana* Gemm,, *Cryptoplocus subpyramidalis* Münst., *Terquemia ostreiformis* d'Orb., *Diceras valfinense* Böhm., *Pterocardium corallinum* Leym., *Cyprina argoviensis* Moesch., *Camptonectes virdunensis* Buv., and many other forms. On the base of this fauna the limestones are regarded as Sequanian in age.

Further on the high-road goes by a number of sanatoria.

Higher up the slope, at the upper road are located the large settlements Gaspra, Koreiz, Miskhor; the first of these, is the rest-home of scientists; here lived and rested the famous writer Leo Tolstoi. The two towers of this Gothic building are beautifully outlined against a background of greenery when one is passing along the lower road. Beside the above mentioned highroad passes along a whole line of sanatoria and rest-homes up to a rather small divide range, on the boundary between the regions of Alupka and Miskhor.

From this divide range a beautiful view can be obtained of the Alupka amphitheatre. It corresponds to the north-east trending syncline of the Andian folding phase, this phase involving in its movement both the shales and sandstones of the Southern Coast and the limestones of the Yaila Mountains.

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[1] „The Swallow Nest“.

The most beautiful of the Crimean Mountains, the Ai-Petri, lies on the anticlinal bend of this folding. The syncline corresponds to the ancient Alupka landslide which preserves now but little activity; this however has manifested itself by the destruction of the buildings in Alupka. Owing to a dome-like uplift of the Yaila at the close of the Tertiary period the syncline acquired a rather steep slope seaward. This made possible a displacement along the syncline of products of destruc'ion of both the shale-sandstone and the limestone series, and these products accumulated naturally in the syncline. Thus, there is present a number of conditions favouring the development of the landslide process, which gives rise to an intense denudation of the shore.

Frequent destructions of buildings connected with the displacement of the landslide, increasing its activity in humid years, necessitated the erection of special constructions for the struggle against landslides. Of such ought to be mentioned the drainage galleries. The region of Alupka belongs to those tracts of the shore which are subject to subsidence. Owing to this fact we observe in the coastal zone the development of a modern stage of the landslide along a landslide curve which is in conformity with the present base level. A deeper bed and the buried beach which has sunk to a depth of 5 m was revealed by prospecting works.

The health resort Alupka possesses a splendid park in which the so-called „chaos" is one of its best and most picturesque corners. This „chaos" is an outcrop of diabase destroyed by the landslide; the diabase blocks are scattered without any order all along the slope down to the shore. From this rock is also constructed the former palace of Vorontsov which is now transformed into a Museum of history.

4 km past Alupka the high-road crosses the amphitheatre of Simeiz. The synclinal bend of the Yaila limestones, corresponding to the Simeiz syncline trending north-east, is clearly shown in the bluff of the Yaila.

In the region of that syncline a vigorous detachment of separate limestone massifs is going on; these huge limestone blocks form five steps in the Simeiz amphitheatre. Simeiz is the terminal point of the lower branch of the high-road; further, a ground road runs along the sea coast. Its initial part

crossing Mount Koshka (Cat) is especially picturesque. Above the road the steeply dipping limestones rise in an abrupt bluff; below, numerous fancifully outlined limestone massifs and cliffs spread out far into the sea; with them many poetic Tartarian legends are connected. Beyond the bend in the road the Lemeny amphitheatre can be seen. From its western side it is flanked by the Khyr-Pyliaki Range, built up of eruptive rocks and volcanic tuffs. The eruptive rocks correspond in age to the Lower Bathonian, this being evident from the occurrence in the tuffs and in patches of enclosed sedimentary rocks, of *Lytoceras adelae* d'Orb., *L. ilanense* Strem., *Posidonia buchi* Roem., etc. Among the eruptive rocks are present albite diabases and keratophyres (albitophyres). The spheroidal parting which is observed rather frequently, a great quantity of vesicular lava and the alternation of tuffs with argillaceous shales point to the submarine character of the eruption.

The igneous rocks are exposed in the centre of the large north-east trending Lemeny brachyanticline highly uplifting the argillaceous shales and sandstones, on to the level of the Yaila Plateau. By a transverse fault the lower part of the anticline is displaced eastward in respect to its northern part. The fold, in regular stratigraphical order is surrounded by concentric outcrops of Triassic shales with *Pseudomonotis caucasica* Witt. and *Halobia* aff. *neumayri* Bittn. of Carnian or Norian ages. Higher follow unfossiliferous sandstones and conglomerates assigned to the Liassic and argillaceous shales and sandstones of Middle Jurassic age containing in their upper part a rich fauna belonging to the upper parts of the Bajocian and the lower parts of the Bathonian. The argillaceous shales of Aalenian age usually contain only the widely distributed form,— *Posidonia buchi* Roem. The Middle Jurassic is unconformably overlain by Sequanian limestones with *Ptygmatis pseudobruntrutana* Gemm., *Itieria cabaneti* d'Obr., *Tylostoma corallina* Etall., *Chlamys viminea* Sow., and many other forms. The Koshka Range composed of limestones, separating the Lemeny region from that of Simeiz represents the remains of a limestone cover, originally continuous, which was somewhat displaced south-eastward along the slope of the south-eastern wing of the Lemeny brachyanticline; the remains of that lime-

stone cap are also preserved on the summit of the range and at the south-west border of the brachyanticline which terminates by Cape Troitsa (Trinity). At the sea coast are preserved remains of a Riss-Würmian terrace including *Mytilus gallo-provincialis* Lam., *Venus gallina* Lam., *Ostrea taurica* Krin., etc. A tongue of the ancient Lemeny landslide is encroaching upon this terrace, owing to which the age of the landslide can be fixed with accuracy. Further displacements of this landslide are documented by remains of Palaeolithic and Neolithic cultures.

Thus, an accurate chronology of the development of the landslide process on the Southern Coast can be established. The central part of the Lemeny amphitheatre is occupied by rocks produced by landslide phenomena. Among these the main varieties are: delapsium — a coarse clastic rock produced by simple landslide movements of the mountain rockfall type, and detrusium, — a fine clastic rock somewhat compacted in the result of the movement of the landslide flow or the landslide in the strict sense of this word. The extremity of Cape Troitsa is occupied by a broad abrasion terrace.

The Lemeny brachyanticline displays an asymmetric structure; its south-eastern wing being steeper than the north-western. Beyond the turning of the high-road sweeping about the foot of Peak Khyr, can be seen the gently sloping north-western wing of the anticline, complicated by secondary folding of more recent age.

Probably, a Maeotic age may be assigned to this folding. A small anticline owing its origin to the mentioned folding separates the Kekeneiz region from the contiguous Kuchuk-koy region; this latter coincides with a rather large Kuchuk-koy syncline complicated by the anticlinal uplift of the small Uzun-tash crest. In that syncline lies the Kuchuk-koy landslide, the largest of all those of the Southern Coast and renowned by the catastrophic results of its movement. A spur bounding the Kuchuk-koy landslide allows to observe the full succession of rocks constituting the Southern Coast.

In the lower part of the section and in the centre of the disrupted folds occur black Triassic shales, belonging to the Carnian or Norian stages. In these shales are distinguished two horizons: the lower with *Pseudomonotis caucasica* Witt.

and the upper — with *Halobia* aff. *neumayri* Bittn. Higher follow quartzite sandstones and conglomerates of the Middle Liassic and dark-grey argillaceous shales with *Posidonia buchi* Roem. and *Mytiloides amygdaloides* Goldf. of the Aalenian stage. These deposits are conformably overlain by argillaceous shales with sphaerosiderite nodules, by sandstones, tuffites, and bitumenous limestones of the Bajocian and Bathonian stages, containing a rich and varied fauna of large ammonites (*Lytoceras adelae* d'Orb. etc.) which exceed half a metre in diameter. Here are encountered *Phylloceras kudernatschi* Hauer, *Ph. disputabile* Zitt., *Ph. subobtusum* Kuder, numerous lamellibranchs, gastropods and brachiopods. Detailed measuring and plotting of the Middle Jurassic section (a succession of about 1500 different rock layers) revealed that partings of definite thickness are reoccurring in the section at regular intervals, the fact being an evidence of the cyclicity of the sedimentation process in that region. The Middle Jurassic is unconformably overlain by the Yaila limestones falling into two series: viz. the Yaila limestone series and the series of argillaceous limestones and marls. The first of these series may be subdivided into two parts — the lower, consisting of grey, oolite-like limestone (microconglomerate) of Sequanian age, and the upper inclusing compact reddish limestones of Lower Kimeridgian age. These limestones yielded: *Nerinea eugeniensis* Pčel., *Cryptoplocus depressus* Voltz., *Diceras guirandi* Lor., *Solenopora jurassica* Nich., and about fifty other species of gastropods, lamellibranchs and brachiopods. The argillaceous limestones and marls furnished: *Aspidoceras acanticum* Opp., *Oppelia nerea* Opp., *Dicyclina lusitanica* Choff., *Natica hemisphaerica* Roem., and many other forms, pointing to the Upper Kimeridgian age of this series. The Quaternary system is represented by a mantle of loose deposits, including deluvium and rocks formed in result of landslide movements (delapsium and detrusium). Lithologically these deposits are subdivided into limestone, schistose-sandstone and mixed rocks. The mantle of loose deposits is subject to the energetic movements, which are favoured by the steepness of the slopes, an easy destructibility of the majority of the country rocks here observed, and a peculiar tectonics, resulting in the formation of seawards pitching synclines in which all the loose deposits are accumulating and

into which all the underground waters are draining. Owing to this, a permanently developing landslide process is under way, realizing the transfer into the marine basin, along special thalwegs of the destruction products of the weathering country rocks.

On the Southern Coast most various forms of movements can be observed and all these movements are closely linked up into a single system. The main movements are: 1) Movements of country rocks (rock waste, rock falls, detachment of separate massifs) accumulating great thicknesses of delapsium at the local isolated bases of denudation. 2) Plane movements of masses of delapsium from the local bases of erosion and denudation toward the thalweg of the landslide; in the course of these movements chiefly by mechanical action, the delapsium is gradually converted into detrusium. 3) A continuous linear movement of the detrusium toward the base level of erosion, along thalwegs worked out to the extreme equilibrium curve of rocks.

The Kuchuk-koy landslide is the most vigorous on the Southern Coast, being remarkable for its size and the disastrous character of its movements. Both for its study and the working up of methods of a complex stationary investigation of landslides, the Central Geological and Prospecting Institute (Leningrad) organized the Crimean Landslide Station, situated on the landslide itself, on the sea-coast, near the health resort Kastropol. In the course of 6 years the station has conducted regular observations on hydro-meteorology, geodetic marks, and on experimental hydrogeological and landslide tracts. The laboratories of the station study the hydrochemical regime of the underground waters and the changes of the physico-mechanical constants of the landslide grounds.

The station is publishing the 6 th volume of its transactions which sum up the works of the station and its methodical experience. The Crimean Landslide Station worked up a full scheme of further prospecting and stabilization works of the whole body of the landslide.

At a distance of 4 km from the above mentioned landslide the high-road crosses another landslide named „Chernyi Bugor". The „Chernyi Bugor" belongs to a number of ancient landslides, whose active development has ceased. It is many-

staged and its base levels have changed repeatedly in connection with the migration of the coastal line. Of great interest is the buried beach (Riss-Würmian terrace), resting up on an ancient landslide and overlain by débris pushed on by the next following landslide movement. The chronology of the movements of the „Chernyi Bugor" landslide belongs to those most fully worked out. The detachment of a large limestone massif in the upper part of the landslide, above the high-road, caused a disturbance of equilibrium and gave rise to the appearance of the modern very actively developing rock creep on the body of the ancient landslide.

Further on, the high-road passes through the Shaitan-Merdven syncline complicated by a horizontal dislocation with which are connected the exposures of the igneous rocks and tuffs of the Melass Crest, below the high-road. The road goes a short distance down the Melass descent and then begins its ascent to the Baidary Pass, over the Yaila Mountains; on the highest point of the pass are located the Baidary Gates.

The Southern Coast on this tract is deprived of cultural plants, is deserted and scantily populated, preserving all the peculiar flagrance of its original wilderness. However, here also there is a number of large sanatoria and rest homes. Up the ascent, half way to the Baidary Gates, the road goes past the former church of Foros, built on a cliff and now transformed into the restaurant of „Kurortsnab".

From the platform opens a wide panorama on the adjacent part of the Southern Coast — from here the abrasion terrace of Cape Foros, identical to that of Cape Troitsa, can be traced in all its details. To the right is seen the landslide of Foros, in the form of a stone river of delapsium, creeping down the slope, from the foot of the steep scarp of the Yaila.

From the Baidary Gates a view is obtained of the Baidary valley. As to its origin the Baidary valley corresponds to a syncline of Jurassic and Lower Cretaceous deposits, covering its floor. The limbs made of Tithonian limestones are slightly thrust upon the greenish Valanginan clays. The structure of the valley is complicated by a transverse fault, by which the Foros Cliff was pushed far to the south. The valley represents a natural drainage for the karst waters of the lime-

stone plateau of Yaila, and under the influence of these waters, appearing on the surface, it assumed the external configuration of a „polje".

Beyond the Baidary valley there is an ascent to Perovski Pass from which the high-road runs down to the Varnutka valley, and passes near its northern slope which is built up of grey and pinkish breccia-like limestones of Tithonian age. The central part of the valley consists of uniform greenish

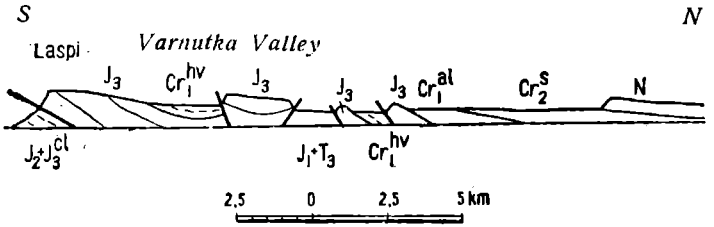

Fig. 5. Schematic Profile across Laspi and Varnutka Valley in the South-Western Part of the Mountainous Crimea.

N — Sarmatian. Medilerranean beds; Cr_2^s — Senonian; Cr_1^{al} — Albian; Cr_1^{hv} — Valanginian-Hauterivian; J_3 — Upper Jurassic; $J_2 + J_3^{cl}$ — Callovian and Middle Jurassic; $J_1 + T_3$ — Tauric shales; / Fault.

Neocomian clays. The composition of the fauna makes evident the presence here of Valanginian and Hauterivian deposits. Here are encountered *Phylloceras calypso* d'Orb., *Kilianella paqueri* Sin., *Aptychus angulicostatus* Pic. Camp., *Duvalia lata* Bl., *Pseudohiboulites bipartitus* Bl., etc.

Such an interrelation of the Upper Jurassic and Lower Cretaceous rocks, i. e. when in direct vicinity the former lie higher than the latter, — is dependent on the presence of a fault disturbing the symmetry of the short cup-like syncline which the Varnutka valley represents. This fault is readily distinguishable at the high-road barracks; there the road turns into the narrow gorge of a rivulet named Sukhaya Balka. The fault fissure is filled by a limestone breccia up to 4 m in thickness. The dislocation took place along a nearly vertical plane, with an amplitude of about 40 m. Both borders of that narrow gorge consist of the same Tithonian limestones containing a rare

fauna among which the following forms can be mentioned: *Iteria rugifera* Zitt., *Nerinea angustata* Pčel., *Terebratula moravica* Glocker and *T. kelheimensis* Schi. This gorge leads us to a depression which, like the Varnutka valley, is filled by Neocomian clays, including the same fauna of belemnites *Aptychus* and, rarer, ammonites.

On the north this depression is also bounded by a fault which separates the Lower Cretaceous formations from the surmounting ridge of Upper Jurassic limestones of Mount Gosfort; on this mountain is situated an ancient Italian cemetery dating from the defense of Sevastopol during the Crimean war. Ascending this depression from the Kamary highroad barracks, the road enters the region of development of Albian deposits. Here we say farewell to the Mountainous Crimea proper, and to the First Ridge of the Crimean Mountains, in the structure of which participate almost exclusively Jurassic deposits. The Albian sandstones contain a rather abundant fauna among which are encountered: *Kossmatella agassizi* Pict., *Puzozia mayori* d'Orb., *Hoplites interruptus* Sow., *H. dentatus* Sow.

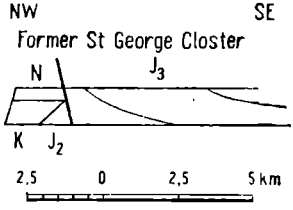

Fig. 6. Schematic Profile of the Western Slope of the Crimean Mountains.

N — Mediterranean beds-Sarmatian; J_3— Upper Jurassic; J_2 — Middle Jurassic; K—Keratophyres; / Fault.

By a short zigzag ascent the high-road leads to the Sapun Heights from where opens a broad view of the flat surface of the plateau, on which lies the English cemetery, and somewhat further the French, both clad in greenery and dating from the defense of Sevastopol.

The panorama which unfolds from the Sapun Heights to the east and south-east is among the finest in the Crimea. The horizon line ends with the Yaila, its northern slope. Through a narrow gorge can be distinguished a part of the sea bay, the buildings of town Balaklava and the Genoese towers rising on the hill above the town. The valley between the First and Second Ridges as well as the Second Ridge itself made up of Upper Cretaceous rocks, can be viewed from the side.

The Sapun Heights consist of Sarmatian limestones with: *Mactra podolica* Eichw., *Tapes gregaria* Partsch, *Ervilia podolica* Eichw., *Trochus podolicus* Dub., etc. On these same limestones is also situated town Sevastopol. The escarpments of the limestones are well exposed on the borders of a deep ravine along which the highroad descends to the Sevastopol railway station.

FROM YALTA TO BAKHCHISARAI VIA KOKKOZ VILLAGE

By *G. WEBER*

Leaving Yalta, the high-road proceeds past Livadia, crossing the area of Tauric shales. Among these shales, in Chainaya Street, is a small outcrop of dark grey Liassic limestone with pelecypods, brachiopods and crinoids; below the Livadia suburb, — an outcrop of diorite. The Tauric shales are succeeded by Middle Jurassic shales interbedded with greenish-grey sandstones. At places the Middle Jurassic is exposed along the high-road 4.5 km west of the Livadia suburb. From the road a view is obtained of the Uchansu valley and of the landslips of Upper Jurassic limestones near Autka village. The valley conforms in direction with the dislocations which are clearly shown in the head parts of the Uchan-su and Yauzlar rivers. Thanks to these dislocation the Upper Jurassic limestones of the Mount Stavri-Kaya bounded by the mentioned rivers have subsided. Further, the high-road approaches the abrupt south-western face of the Yaila made of Lusitanian limestones. Both bedded and massive limestones enclosing a rich fauna of corals, sponges, pelecypods and gastropods are developed near the Uchan-su falls.

Beyond Uchan-su the road runs up the slope till the pass between the Mount Megabi and Mount Pendikiul, — a spur of the Yaila. That part of the road crosses a series of landslips of Lusitanian limestones among which Middle Jurassic shales appear in places. In a distance of 2 km from the Uchan-su fall is a small outcrop of porphyrite among Middle Jurassic

shales. Near Karagol Fountain is a landslide of shale deluvium in which the trees growing on the slope have been involved (the „Tipsy wood").

Mount Megabi is made of Lusitanian limestones, sandstones and conglomerates. From the pass the high-road ascends toward the top of Mount Pendikiul which is composed of limestones of same age, abounding in corals. The limestones are highly fractured. After several very sharp bends the high-road reaches the top of the Yaila at Shishko Cliff where the Meteorological Station is located. From here a splendid view opens up of the Southern Coast (Alupka, Koreiz, Yalta), as well as of the crenulated summit of Mount Ai-Petri, made of Lusitanian limestones dipping NW ∠40°. Mount Aiu-dagh is seen in the distance and the outlines of the Sudak Mountains at the horizon. In the region of Mount Shishko the Yaila displays a typical karst topography, the Upper Jurassic limestones dipping NW ∠20° being cut by an ancient denudation surface. The Cliff Shishko is made of rather compact, bedded limestones of Lusitanian age, enclosing corals, sponges and pelecypods (*Hinnites*). A particularly abundant fauna of corals, mollusks, brachiopods and echinoids occurs in the marly Sequanian limestones exposed at a spring to the north of Mount Shishko. This fauna includes: *Epismilia rugosa* Mil., *Cryptocoenia dicipiens* Et., *Cr. tenuistriata* Koby, *Cyatophora bourgueti* Defr., *Favia lobata* Koby, *Thamnastrea approximata* Eichw., *Acrocidaris borissiaki* Web., *Salenia taurica* Web., *Rhynchonella pinguis* Roem., *Rh. corallina* Leym., *Terebratula etalloni* Roll., *T. valfinensis* Lor., *T. ouzenbachensis* Mois., *Harpagodes oceani* var. *levandovskii* Pč., *Natica georgeana* d'Orb., *Oonia taraktaschi* Pč., *Sequania lorioli* Cosm.

Thickness of the Sequanian — about 400 m.

The nearly level plateau of the Yaila is composed of Kimeridgian and Lusitanian marly, thin-bedded, grey, occasionally yellowish limestones with sandstone interbeds.

The light-grey, thin-bedded limestones of Kimeridgian age enclose rare ammonites, also *Natica hemisphaerica* Roem., *Dicyclina lusitanica* Egg., etc. Thickness of strata, about 200 m.

The fractures observed in the limestones at the southern edge of the Yaila (head parts of the Barbala and Uchan-su rivers) are continued farther north-westwards and are crossing the Yaila. Owing to this, in the limestone series constituting the summit of the Yaila a repetition of beds is observed.

At the northern edge of the Yaila rises the Mount Bedenekyr, made of compact, thick-bedded Kimeridgian limestones. On the summit of that mountain a mighty wind-power installation is being constructed.

After passing over the eastern spur of Mount Bedenekyr the high-road reaches the northern slope of the Yaila. At the

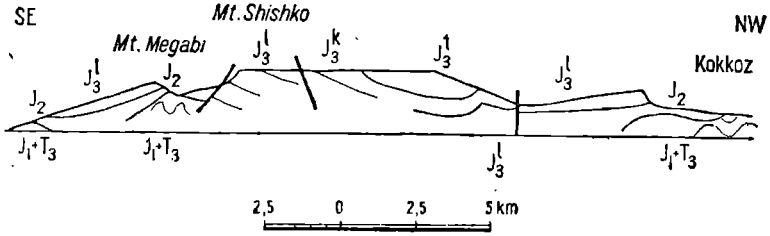

Fig. 7. Schematic Profile across Mts Megabi and Shishko and Kokkoz Village.

J_3^t — Tithonian; J_3^k — Kimeridgian; J_3^l — Lusitanian; J_2 — Middle Jurassic; $J_1 + T_3$ — Tauric shales; / Fault.

beginning of the descent, between the 6th and 8th kilometers from Mount Shishko is an exposure of the Tithonian.

This is represented by light-grey and yellowish limestones with marl interbeds, at places including a very rich fauna of corals, echinoids, pelecypods and gastropods: *Stylina arborea* Arch., *Latimaeandra goldfussi* Koby, *Dimorpharea koechlini* Quenst., *Microsalena*, *Cryptocoenia*, *Montivaultia rosula* Eichw., *Thecosmilia irregularis* Et., *Pseudocidaris vogdti* Web., *Tiaris* cf. *leymeriei* Cott., *Mytilus furcatus* Münst., *Alectryonia*, *Itieria rugifera* Zitt., *Natica phasianellaeformis* di Stef., *Natica venelia* Lor.

Thickness — about 200 m.

Further the high-road is winding among grey thick and thin bedded Tithonian and Kimeridgian limestones. In a distance

of 12 km. from Mount Shishko crop out grey and yellowish Tithonian marly limestones dipping NW ∠ 20° and enclosing a very rich fauna of corals, echinoderms, pelecypods and gastropods: *Itieria rugifera* Zitt., *Ptygmatis yalpachensis* Vogdt., *Ptygmatls pseudobruntrutana* Gemm., *Nerinea jeanjeani* Roem., etc.

Looking west from the high-road the deep valley of the Kuru-uzen River can be discerned, as well as the mounts Sary-kaya, Siyuriu-kaya and Sedam-kaya which are made of grey compact and bedded Lusitanian limestones; these limestones dip to the south, while those of the northern slope have a NW dip and form a syncline. The southern dip of the limestones may be observed at one of the turns in the road. The Mount Sedam-kaya lying farther north presents a sharp syncline in grey Lusitanian limestones with: *Rhynchonella moeschi* Roll.; and in Kimeridgian and Lower Tithonian reddish and grey massive limestones with brachiopods and echinoids: *Terebratula moravica* Glock., *T. formosa* Suess, *T. insignis* Sch., *Rhynchonella hoheneggeri* Suess, *Cidaris*, etc.

West of the Sedam-kaya, in the Kurtler-bogas and Siyuriu-kaya mountains the Upper Tithonian is represented by oolitic and arenaceous limestones carrying the gastropods: *Ptygmatis yalpachensis* Vogdt, *Pt. carpatica* Zeusch., *Phaneroptyxis kokkozensis* Vogdt, *Cryptoplocus kokluzensis* Vogdt, *Nerinea hoheneggeri* Peters, *Nerinea salinensis* d'Orb., *N. posthuma* Zitt., *N. jeanjeani* Rom., *Procerithium rectum* Pč., *Triptyxis acutecochleata* Broili.

From the high-road barracks the descent becomes steeper again and the road winds in a series of sharp zigzags.

In a distance of 17—18 km from Mount Shishko the road side exposes a series of bluish-grey arenaceous, irregularly bedded Lusitanian limestones with wave marks and small fragments of coal; the limestones dip NW at ∠30°; in them *Nerinea yailensis* Pč. and ammonites have been discovered.

At the last sharp bend in the road a view opens up of Mount Boika made of massive Upper Jurassic limestones in which a deep gorge (the „Great Canyon") coinciding with the fracture line is incised. Below, the bedded Sequanian lime-

stones are discernible, and still lower, — the Middle Jurassic shales. The Upper Jurassic limestones are dislocated along the surface of the shales.

Descending toward the rivulet Kokkoz the high-road follows along a steep slope mantled by débris of Upper Jurassic limestones among which, at the very beginning of the ascent, the Middle Jurassic shales interbedded with greenish-grey sandstones enclosing poorly preserved plant remains are to be observed in situ. Similar shales extending as far as the Kokkoz village are exposed in the road siding. The Kokkoz valley is bounded on the south by the Main Ridge (made of Upper Jurassic rocks), with its summits, — Bechku, Pambuk, Western Siyuriu-kaya, Yalpakh, Kurtlerbogaz, Sedam-kaya and Mount Boika. On the west and the north — by a crest of Lower Cretaceous rocks, with the summits Kaia-bash, Ilka, Ak-yar, Karatlykh and Chuku. It is notable that in the south a mighty series of Upper Jurassic rocks is present, while in the north the Lower Jurassic sandstones are separated from the Tauric shales by a relatively thin series of Upper Jurassic conglomerates whose thickness at Airgul village is but 4 m. These conglomerates are here resting upon the abraded surface of the Tauric shales. To the west of Kokluz village along the Suatkan river among the conglomerates at the base of the Lower Cretaceous eroded reefs of Upper Jurassic limestones are preserved. The central part of the valley is composed of argillaceous shale, of Middle Jurassic age in the south and west, and of Liassic and Triassic age, in the north and east. At Kokluz village the shales were found to contain the Dogger forms: *Oppelia aspidoides* Opp., *Posidonia buchi* Roem., and near Uzenbash village Bajocian *Parkinsonia parkinsoni* Sow., as well as plant remains (*Cladophlebis*, *Sphenopteris*, etc.).

Near Kokkoz village there are present outcrops of igneous rocks — porphyrites. The Middle Jurassic makes up in the Kokkoz valley a brachyanticline in the core of which Tauric shales crumpled into small folds are exposed.

The Main Ridge of the Crimean Mountains is separated from the ridge of Cretaceous rocks by a fracture extending along the valley of the Suatkan River (to the west of the Kokkoz valley), and to the east of it, by a zone of highly crumpled

and crushed Middle Jurassic and Tauric shales. It appears that the presence of nitrogen and noble gases in the Adji-su spring near Eni-Sala village is due to these dislocations.

Mounts Chuku and Karatlykh in the region of the Cretaceous ridge show the following succession of rocks.

1.	Upper Turonian. Compact, white, breccia-like limestones with *Inoceramus* ex gr. *lamarki* Park., *Terebratula becksi* Schlönb., *Rhynchonella cuvieri* Sow., *Conulus subconicus* d'Orb. Thickness	2 m
2.	Lower Turonian. Compact, resonant marls. Thickness	20 „
3.	Cenomanian. Light, greyish, argillaceous marls presenting an alternation of finely laminated soft layers with more compact ones. Thickness	20 „
4.	Vraconnian sub-stage. Loose, greenish-grey glauconite sandstones with *Aucellina gryphaeoides* Sow. and *Neohibolites* ex gr. *ultimus* Sow. Thickness	10 „
5.	Middle and Lower Albian. Arenaceous limestones grading downwards into conglomerates of white quartz pebbles. Thickness	15 „
6.	Urgonian. Grey nodular limestones with gastropods: *Nerinea vogdti* Pč. and *Diozoptyxis coquani* d'Orb. Thickness	20 „
7.	Hauterivian. Yellow-grey oolitic limestones with sponges, corals, rests of echinoderms and pelecypods: *Exogyra subsinuata* Leym., *Ex. minos* Coq., *Alectryonia, Neithea, Lima, Chlamys*, etc. Thickness	3—4 „
8.	Valanginian. Greenish-brown glauconitic sandstones with arenaceous limestone partings, enclosing *Thurmannia boissieri* Pict., *Spiticeras negreli* Math., *Sp. arginensis* Vogdt, *Berriasella terenairensis* Zebr., pelecypods, gastropods and corals. Thickness	30 „
9.	Upper Jurassic. Conglomerates composed of large limestone, sandstone and shale pebbles, spherosiderite, etc., as well as of large and fine quartz fragments. Farther westwards, an imprint of an ammonite approaching *Perisphinctes transitorius* Opp., has been discovered in the conglomerate. Thickness	4—10 „

Passing by the villages Kokkoz and Foti-Sala the high road follows along the narrow valley of the Belbek River made up

of Lower and Upper Cretaceous rocks succeeded by Paleogene ones.

To the north of Foti-Sala village, in a distance of 10 km of Kokkoz village is, a deep ravine running westwards from the Mount Karatlykh. In the lower part of the ravine Upper Jurassic conglomerates and Valanginian sandstones are developed. By the bridge at Otarchik village the high-road crosses the series of Urgonian limestones which are overlain by Albian conglomerates, Cenomanian and Turonian marls and limestones. A good exposure of the latter is found in the left bank of Belbek River. The white marls extending farther north up to

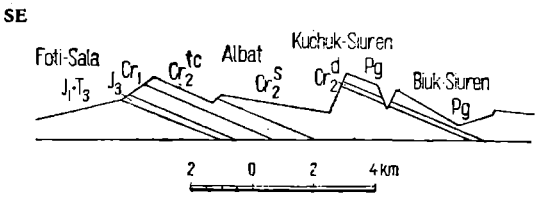

Fig. 8. Schematic Profile along the Right Slope of the Belbek River Valley between Foti-Sala and Biuk-Siuren Villages.

Pg — Eocene — Paleocene; Cr_2 — Danian stage; Cr_2^{s}— Senonian; Cr_2^{tc} — Turonian-Cenomanian; Cr_1 —Albian, Urgonian Valanginian; J_3 — Upper Jurassic; $J_1 + T_3$ — Tauric shales.

Albat village are to be referred to the Campanian and Santonian beds, while the named village itself lies upon Campanian marls with: *Inoceramus balticus* Boehm, *Belemnitella mucronata* Schloth. and sponges. Beyond Albat village the Belbek valley rapidly narrows and its borders made of Upper Cretaceous and Lower Tertiary rocks become abrupt. This place is known as the Albat Gates. In the steep valley borders on both sides of the stream the following succession of rocks is beautifully exposed.

1. Paleocene. Montian stage. White and yellowish coarse-grained, at places, porous limestones with voids from dissolved shells of: *Pycnodonta montensis* Br. et Corn., *Exogyra eversa* Desh., *Corbis taurica* Elchw., *Corbis davidsoni* Desh., *Turritella montensis* Br. et Corn., *T. coemansi* Br. et Corn. Thickness . . . . . 25 m

2. Danian stage. A soft white and yellowish limestone composed of bryozoary detritus, among which occur stem segments of *Burgueticrinus* sometimes forming thin continuous partings, *Crania tuberculata* Nils., rarer other brachiopods, also oysters (*Pycnodonta burkhardti* Web., *Exogyra lateralis* Nils.) and echionids (*Cidaris, Salenia, Diplopodia,* etc.). Thickness . . . . . 20 m
3. Soft glauconitic sandstones exposed in the road cutting, with oysters and pectinids (*Exogyra decussata* Goldf., *Pycnodonta similis* Pusch., *Equipecten meridionalis* Eichw., *Chlamys cretaceus* Defr., *Neithea*). Thickness . . . . . 10 „
These beds gently grade into the
4. Maastrichtian stage. White, compact, glauconite sandstones enclosing the same oysters and pectinids as well as *Belemnitella americana* Mort. Thickness . 25 „
5. White, chalk-like marls with *Scaphites constrictus* Sow., *Pachydiscus neubergicus* Hauer, *Baculites knorri* Favre, numerous gastropods and pelecypods. Thickness . . . . . 30 „
6. Campanian stage. White marls with *Belemnitella mucronata* Schloth., *Hauericeras pseudogardeni* Schlüter *Inoceramus regularis* d'Orb., *In. balticus* Boehm and other pelecypods, also sponges. Thickness . . . . . 50 „
All these rocks dip NW at ∠8—10°.

In a distance of 6 km from Albat village lies an abandoned quarry in which the Maastrichtian and Danian glauconitic sandstones have formerly been extracted. Here a rather well preserved fauna can be collected.

1 km farther north the caves (undercut caves), Siuren I and Siuren II are located, in which were found flint implements of the Aurignacian and Madelenian cultures.

The high-road further crosses a ridge of nummulitic limestone of Lutetian age and enters the longitudinal valley which separates the Second Ridge from the Third and is made of white Eocene marls.

In the north-west is visible the Third Ridge of the Crimean Mountains, the summit of which is formed of Mediterranean and Sarmatian beds. The beds dip at a low angle NW ∠4°.

Town Bakhchisarai — the center of the Bakhchisarai region of the Crimean Autonomous Socialistic Soviet Republic is located 32.5 km from Simferopol and 46.5 km from Sevastopol. It is an ancient town, the former residence of Tartarian khans

Of the ancient monuments there are preserved a fountain, a mosque and a palace. The latter is now occupied by the Museum of the Regional Studies. Ancient cave settlements have remained in the vicinities of Bakhchisarai (Chufut-kale, Tepe-Kermen). Near the railway station, along the high road, passes the boundary of the Bartonian marls and Middle Eocene limestones.

The town lies $1^1/_2$ km south-eastward in a deep gorge carved by the Churuk-su rivulet in the Second Ridge. The abrupt upper part of the slope consists of nummulitic limestones, and its lower gentler part — of Eocene clays and Paleocene marls.

Near the castle, on both sides of the gorge Paleocene marls make their appearance. The right slope of the gorge displays the following succession of rocks, dipping at NW ∠ 8—10°.

1. Middle Eocene. White and yellowish coarse limestones with *Nummulites distans* Desh., *N. tchichatchevi* Arch., *N. ramondi* d'Arch., *Gigantostrea rarilamella* Desh., *Pecten serratus*. Thickness . . . . . 25—30 m
2. Greenish-grey marlaceous clays containing the same fauna and *Assilina exponens* Sow. Thickness . . . . . 30 „
3. Paleocene. Bluish-grey marls with a rich microfauna, and rare *Pecten prestwichii* Morr., *Ostrea reussi* Netsch. Thickness . . . . . 15 „
4. Greyish-white marls with a rich fauna of *Cucullaea volgensis* Barb., *Cytherea tocodensis* Opp., *Cardita pectuncularis* var. *euxinica* Schvetz., *Protocardium edwardsi* Desh., *Ostrea orientalis* M. E., *Pycnodonta escheri* M. E., *Chenopus plateaui* Cossm., *Turritella mariae* B. et C. Thickness . . . . . 15 „
5. Sandy marls with the same fauna. Thickness . . . 3 „
6. White and yellowish, semicrystalline in places porous limestones with voids from dissolved shells. Thickness . . . . . 6 „
7. Danian stage Bryozoary limestones. Thickness . . . . . 30 „
8. Soft glauconitic sandstones 2—3 m in thickness, with phosphates and great quantities of oysters (*Exogyra ducussata* var. *taurica* Web., *Alectryonia semiplana* Sow., *Al. ungulata* Coq., *Al.*

lunata Defr.,) and pectinids (*Equipecten meridionalis* Eichw., *Chlamys cretaceus* Defr., *Chl. septemcostatus* Nils., *Amusium nilsoni* Goldf,, *Nelthea substriatocostata* d'Orb., etc.). The lower boundary is marked by a stratum of shell rock (about 0.5 m) with an uneven lower surface, consisting almost entirely of shells of *Equipecten meridionalis* and fauna washed from lower seated beds (*Belemnitella americana* Mart.); this stratum fills the pockets in the underlying more compact Maastrichtian marl forming the second cornice. The lower members of the Danian stage are carved by a number of grottos and undercut caves, which are utilized by the local population for cattle pens, tobacco drying and other purposes. 2-5 m.

9. Maastrichtian stage. Compact yellowish arenaceous marls of the zone with *Belemnitella americana* Mart. with rare glauconite grains. Fauna is of rarer occurrence, mainly in pockets, includes the same oysters as the higher seated horizon; besides this here are found *Ancyloceras retrorsum* Schlot., *Liopista aequalis* Goldf., pelecypods, teeth of sharks and skates, fish scales, etc. Thickness about . . . . . 30 .

10. At the base of the section make their appearance the Lower Maastrichtian white, chalk-like marls, with *Scaphites constrictus* Sow., *Pachydiscus neubergicus* Hauer, *Baculites knorri* Hauer and numerous gastropods and pelecypods.

The excursion proceeds toward Mount Chufut-kale on the summit of which lie the ruins of an ancient cave-town. The base of the mountain consists of Maastrichtian beds, the top, of Danian bryozoary limestones. Looking east lies Mount Besh-kosh made of similar rocks; at its summit, in the lower part of the Danian (beds with *Equipecten meridionalis* Eichw.) bones of a large dinosaurian have been discovered.

The valley extending to the south-east of mounts Chufut-kale and Besh-kosh exposes white marls with a scanty fauna, referable either to the Coniacian, or the Santonian. Still farther south lies a series of hills whose summits are made of Turonian and Cenomanian marls whereas at their base Lower Cretaceous beds are exposed.

Further, at Biasala village the following section is observed:

1. Upper Turonian. Limestone of the zone of *Inoceramus lamarki* Park. Thickness . . . . . 2 m
2. Lower Turonian. White and greyish siliceous marls of the zone with *Inoceramus labiatus* Schloth., splitting into sharp edged laminae and resounding on hitting when struck. Thickness 20 „
3. Cenomanian. An alternation of dark, soft marls with more compact interbeds at intervals of 1—1.2m, the fossils yielded by these beds include: *Inoceramus cripsi* Mant., *Inoceramus etheridgei* Woods, *Schloenbachia varians* Sow. Thickness . . . . . 20 „
4. Vraconnian sub-stage. Loose greenish-grey glauconitic sandstones with *Neohibolites, Aucellina, Inoceramus concentricus* Park; Thickness . . . . . 1—1½ „
5. Lower and Middle Albian. Greenish-grey compact sandstones containing *Puzosia scharpei* Spath., echinoids (*Holaster laevis* de Luc.). *Serpula.* Thickness . . . . . 10 „
6. Aptian. Dark plastic clays with reddish brown spherosiderites in which belemnites are encountered (*Neohibolites semicanaliculatus* Bl., *N. aptiensis* Kil., *Mesohibolites uhligi* Schwetz, *Duvalia grasi* d'Orb., etc.), also very rare, mineralized *Phylloceras* and rhyncholites.
7. Upper Barremian Red stratified argillaceous limestones with ammonites (*Phylloceras, Lytoceras Holcodiscus, Barremites, Silesites,* etc.), frequent brachiopods, rather rare echinoids.
8. Lower Barremian. Conglomerate-like brownish-grey limestones with grains of ferruginous oolite. On a line with Barremian forms of the Mediterranean (*Barremites, Lytoceras, Crioceras, Hamulina*), here are encountered both boreal (*Simbirskites*) and Hauterivian forms (*Crioceras duvali* Lev., *Duvalia dilatata* Bl.). Thickness . . 14 „
9. Hauterivian. The lower part of the slope down to the road is formed of greenish-grey sandstones with glauconite, representing an alternation of loose and more compact beds. At the top of these deposits rather seldom occur pelecypods (*Panopaea gurguitis* Brong., *Exogyra subsinuata* Leym.), echinoids and crustaceans, below is present a richer fauna — echinoids, pelecypods, gastropods, ammonites (rather seldom) (*Astieria scharpei* Kar., *Crioceras kiliani* Sim., *Hap'oceras grasi* d'Orb.). Thickness . . . . . 40 „

The Upper Cretaceous rocks of this section dip at NW ∠ 10° and the Lower Cretaceous—at NW ∠ 15—20°.

In ravines, above Bia-Sale village, are exposed Lower Cretaceous deposits resting upon the eroded surface of the Rhaeto-Liassic shales.

At the base of the Lower Cretaceous occur yellowish-brown calcareo-arenaceous beds with brown grains of ferruginous oolite and fine, brown quartz pebbles containing a very rich Hauterivian ammonite fauna (*Leopoldia leopoldi* d'Orb., *L. karakaschi* Uhl., *L. biassalensis* Kar., *L. pronecostata* Fel., *Astieria scharpei* Kar., *A. spitiensis* Blanf.), gastropods, pelecypods and brachiopods. Thickness . . . . . 4 m

FROM THEODOSIA TO SUDAK

By *A. MOISSEIEV*

Town Theodosia (45°1′ N. latitude, 33°23′ E. longitude) is now the administrative centre and a health resort.

In time of Genoese dominion the town was called Kaffa. It was an important trade .and administrative centre. Of the ancient monuments there are preserved ruins of the so called Tower of St. Constantine and a tower built in time of Pope Clement VI (1345) in memory to the crusade against Kipchak khan Djambek.

Here are also present several churches with icons of excellent mosaic work, ruins of the fortress wall and of the rampart.

The antiquities found are preserved in the Aivazovsky [1] Museum, where there is also a picture gallery of this artist's paintings.

Town Theodosia is situated in the form of an amphitheatre on the slope of Mount Teté-Oba, which on the east ends with the Cape of Saint Elias. This mountain is separated by a valley from the Lysaya mountain (north eastward of town Theodosia). Between the seaport and the Kamyshi and Sarygol villages there is along the sea coast an ancient Quaternary marine terrace which has furnished *Cardium tuberculatum L.*, *Tapes calverti* Newt., etc. (2—3 m above sea level). At Sarygol village lies a salt lake separated from the sea by a spit of sand.

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[1] So named in honour of the famous Russian painter.

The following general geological section has been established in the vicinities of town Theodosia, across the Tete-Oba and Lysaya mountains in a south-northern direction.

1. Tithonian. Grey marls with thin and thick beds of grey limestone which is sometimes conglomerate-like. In these rocks are frequently encountered *Aptychus punctatus* Voltz. The deposits of Tithonian age constitute the southern slope of Mount Tete-Oba and its summit. Thickness . . 600 m.
2. Berriasian. Light-coloured compact resounding marls and clays with thin beds of brecciaclike limestone, containing a rich fauna of ammonites: *Lytoceras honnorati* d'Orb., *Berriasella calisto* d'Orb., *Spiticeras minus* Ret., *Neocomites janus* Ret., *Acanthodiscus incompositus* Ret., etc. Thickness . . . . . 100 „
3. Upper Valanginian and Hauterivian. Greenish clays with subordinate marly beds including *Aptychus angulicostatus* Piet., et Lor., *A. didayi* Coq., *Thurmannia thurmani*. Pict.; Thickness . . . . . 50 „
4. Barremian and Aptian. Dark, bedded clays with siderite nodules containing *Neohibolites semicanaliculatus* Bl., *Mesohibolites uhligi* Schw. Thickness . . . . . 50 „
5. Albian. Dark grey marly clays with *Aucellina* and *Neohibolites minimus* List. Thickness . . . 30 „
6. Cenomanian. Grey and dark marls and marly clays. Thickness . . . . . 20 „
7. Turonian. Light coloured limestones with *Inoceramus lamarcki* Bark., *Conulus subconicus* d'Orb., *Infulaster excentricus* d'Orb. Thickness . 4 „
8. Senonian. A bluish or grey marl with *Scaphites constrictus* Sow., *Inoceramus balticus* Boehm., *Hauriceras pseudogardeni* Schlüter, *Ofaster pilula* Lamb. Thickness . . . . . 80 „
9. Danian. Sandy marls including interbeds of calcareous conglomerates with bryozoas, *Crania* and other brachiopods. Thickness . . . . . 30—40 „
10. Paleocene (Lower Eocene). A compact resounding calcareous marl, containing algae; constitutes the summit of Mount Lysaya. Thickness . . 80 „
11. Middle Eocene. A grey, sandy clay with interbeds of yellowish limestones including small nummulites. Thickness . . . . . 50 „
12. Maikop series. Brownish-grey and green, bedded clays constituting the Steppe region northeastward of town Theodosia (south-western plain of the Kerch Peninsula).

The Jurassic and Cretaceous deposits of Mount Tete-Oba strike SE 120° and dip NE ∠ 20°; the Paleogene deposits of Mount Lysaya strike SE 110° and dip NE ∠ 10°. To the west of town Theodosia these rocks are broken by transverse faults.

Up to Bolshaya Baibuga village the road from town Theodosia to Koktebel passes through the region of development of Paleogene rocks concealed by Quaternary loams (Paleocene and Eocene). The Paleogene rocks form the summits of the crest, extending from Mount Lysaya to the west and situated to the south of the road. In the region of the Bolshaya Baibuga village to the west can be seen Mount Agermysh (near town Staryi Krym) built up of Upper Jurassic limestones.

The road from the above mentioned village turns southward and, follows a valley where are situated two villages—Nasypkoi and further on, Sultanovka. The hill tops, eastward of the road, consist of Paleocene and Eocene rocks. Along the ravines isolating separate hills dislocations can be observed. A transverse fault is also present in the valley over which the high-road passes. To the north of Sultanovka village this fault separates a crest made up of Eocene and Paleocene, Danian and Senonian deposits from the crest Uzun Syrt consisting of the same rocks.

From the pass, at Sultanovka village, the road descends to the sea. From here can be viewed on the south Mount Karadagh and on the north-west — the steep slope of Uzun Syrt; far off, on the west are seen forest-clad mountains built up of Jurassic rocks. To the west of the road are developed Albian, Aptian, Barremian, Hauterivian and Valanginian clays which over a great distance are concealed under Quaternary deposits. Beneath the pass the road runs over Tithonian marls, passes by the crests of Biyuk-Yany-shar and the Yunge Range on the east and the Eger-Oba — on the west, which consist of conglomerates (Kimeridgian and Lusitanian) including blocks of Jurassic limestones and sandstones resting on the Callovian and Middle Jurassic schistose clays, and finally the road reaches Koktebel.

Koktebel (20 km from town Theodosia) is a Bulgarian village in the vicinity of which, on the sea coast, is situated a health resort of the same name, with rest homes,

sanatoria and other medicinal institutions. Eastward of Koktebel is situated cape Kiik-Atlama formed of conglomerates belonging to the Kimeridgian and Lusitanian stages; nearer can be seen cape Toprakh-kaya consisting of Bathonian shaly clays with interbeds of tuffites and siderite nodules containing fauna and rare plant remains.

In Koktebel the following general geological section has been established (south-nortward):

1. Bathonian. Dark and grey argillaceous shales and clays including argillaceous nodules with fauna: *Oppelia aspidoides* Opp., *Oppelia discoangulata* Strem., *Phylloceras kobselense* Strem., *Phylloceras mediterraneum* Neum., *Phylloceras kudernatschi* Hauer, *Phylloceras flabellatum* Neum.
2. Callovian. Grey clays with *Macrocephalites*, including blocks or partings of limestones with *Hecticoceras*.
   All these rocks are strongly dislocated and the higher seated rocks are displaced along them.
3. Lusitanian and Kimeridgian. Coarse conglomerates with blocks of Lower Permian and Jurassic limestones, sandstones and crystalline rocks.
4. Tithonian. Marls and clays with limestone interbeds.
5. Berriasian. Light-coloured marls.

In the region of Koktebel the Upper Jurassic deposits strike NE 80° and dip NW ∠ 85°.

Mount Karadagh represents a complex group of ancient volcanoes. Before the revolution the most detailed study of Mount Karadagh was carried out by A. Lagorio. In the last decennium a detailed investigation of that mountain was made by Academician F. Lœwinson-Lessing and E. Diakonova-Savelieva.

The orography of the Karadagh can be represented as follows:

1. A crest extending along the sea (the mountains Karagach, Khoba-Tepé, Magnitnaya, Kok-kaya from east to west).

2. The isolated „Svyataya Gora" (Holy Mountain) built up for the most part of paleoliparites and trass rocks.

3. Several isolated volcanoes: Shapka Monomakha, the Lobovoy Laccolith, Bolshaya Stena (on the southern slope of Mount Karadagh).

On the Karadagh are observed lava flows, complex series of alternating lava sheets and tuff beds, necks, dykes, veins, small intrusive and extrusive massifs. The tuffs yielded a Bathonian and Bajocian fauna, whereas the limestone partings of the argillaceous shales — a Callovian fauna. Submarine eruptions took place on the Karadagh during the Middle Jurassic and possibly the Callovian ages; Mount Karadagh is characterized by its complex petrographical composition; it represents an assemblage of different volcanic rocks, ranging from basalts to liparites.

F. Lœwinson-Lessing subdivides the rocks of the Karadagh into 3 groups of different age both of paleotypal and

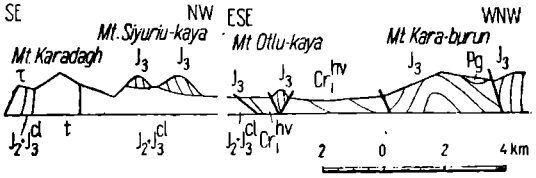

Fig. 9. Schematic Profile of the North-Eastern Part of the Mountainous Crimea in the Vicinity of Mt. Karadagh.

Pg — Eocene; Cr_1^{hv} — Valanginian, Hauterivian; J_3 — Upper Jurassic; $J_2 + J_3$ — Middle Jurassic Callovian; t — Tuffs; T — Trass; / Fault.

cenotypal rocks; it should be noted that in all these groups both acid and basic rocks are present.

The sequence of the 3 cycles of eruption of the magmatic rocks can be represented as follows:

1. The ancient group with one representative: the ultra-acid oxykeratophyre (i. e. keratophyre with surplus of silica and the absence of visible quartz).

2. The paleotypal series embracing such rocks as spilites, keratospilites, keratophyres, oxykeratophyres and paleoliparites.

3. The cenotypal series including basalts, andesites, andesito-dacites, trachytes, dacites, liparito-dacites and finally trasses of the Holy Mountain.

The oxykeratophyres predominating and the keratophyres playing a subordinate rôle, constitute a considerable part of the Karadagh, Khoba-Tepé, Bolshaya Stena ridges and form

in part the Magnitnaya Ridge. These paleotypal leucocratic rocks show traces of aulopneumatolysis.

The spilites and keratospilites form a comparatively narrow coastal zone of the Karagach and Kok-kaya ranges. These rocks are characterized by an amygdaloidal structure and by the formation of flows of pillow lavas. Mount Khoba-Tepé consists of oxykeratophyres.

The palaeoliparites form the south-eastern part of the Holy Mountain.

The younger cenotypal magmatic rocks intrude into the paleotypal mainly in the form of dykes and necks. The major part of cenotypal rocks is represented by andesites or trachyandesites. Basalts are encountered as an exception in the western part of the Karadagh. The oxykeratophyres of Mount Khoba-Tepé are cut by veins of liparitodacytes. There are also present clastic rocks — volcanic tuffs and breccias. In the north-western part of the Holy Mountain are developed trasses.

From Mount Karadagh can be seen on the north-west the Legener Mountain and on the north — Siyuriu-kaya, built up of compact Lusitanian limestones, sandstones and conglomerates.

From Koktebel the road ascends to the pass. Mount Tatar-Khoburga (in the north-east) built up of Kimeridgian conglomerates, and the crest (in the south) formed of Lusitanian limestones. The road passes over Middle Jurassic and Callovian shales. Beyond the pass, in the north is visible the isolated mountain Otlu-kaya. It is formed by steeply dipping Lusitanian limestones, sandstones and conglomerates and from its eastern side is surrounded by Lower Cretaceous clays. The rocks, in this locality, were subject to intense disturbances. The Jurassic deposits are thrust upon the Cretaceous. The road passes through the Otuzy valley made up of Callovian and Middle Jurassic shales, covered by Quaternary deposits. On the south is seen to rise Mount Baly-kaya, consisting of Lusitanian limestones, sandstones and conglomerates, and on the north the Otuz-kaya mountain formed of Kimmeridgian conglomerates. On the west is seen Mount Echki-dagh, consisting of Lusitanian limestones. After passing the Otuzy village the road enters a narrow gorge; at the end

of the village, to the north of the road is present a rather small cliff formed of Lusitanian conglomerates dipping to the south, whereas to the south of the road the conglomerates of the same age, giving rise to Mount Papas-Tepé dip to the north, forming a syncline. The bottom of the above mentioned gorge — up to the western spurs of Mount Echki-dagh, is composed of Tauric shales; its slopes are formed of Lusitanian sandstones, conglomerates and limestones.

Further on, from the Sinor Pass the road descends into the Ai-Van valley; here is situated the Taraktash village. The bottom of the valley consists of Callovian and Middle Jurassic clays and marls. North of the valley the Sary-kaya crest is formed of Lusitanian conglomerates, almost standing on end, and of limestones.

The same rocks give rise to the crest in the southern part of the valley (Mounts Mandjil-kaya, Kilissa-kaya, Tokluk-Syrt). The whole region between Koktebel and Taraktash is characterized by folded structure and strong fractures. The direction of the Otuzy and Ai-Van valleys coincides with the direction of the eroded anticlinal fold. The discontinuous crest comprising Mounts Mandjil-kaya, Kilissa-kaya, Tokluk-Syrt, Ech-dagh, Balaly-kaya, Legener is a syncline. In the north mounts Sary-kaya and the northern Mandjil-kaya display a synclinal structure. These folds are greatly altered by numerous fractures and are broken into separate blocks displaced along the underlying shales. The general strike of rocks is to the north-east.

FROM SUDAK TO SALY

By *G. WEBER*

The health resort Sudak is located on the southern coast of the Crimea, 56.5 km from Theodosia and 95.5 km from Alushta. On the area of the modern town was a settlement in the Pre-Byzantine Greek times; this settlement reached its greatest importance in the mediaeval ages (XI — XIV centuries) during the dominion of the Genoese (Sugdeia, Surozh) who constructed a fortress here, the ruins of which are situated on cape Khyz-kulé-burun.

In the region of Sudak are developed Jurassic rocks:

1. Lusitanian stage. Compact coralline limestones and thinbedded marls with a rich fauna of corals and echinoderms: *Montivaultia*, *Epismilia*, *Leptophyllia*, *Dimorpharea*, *Tamnastrea*, *Latimaeandra*, *Isastrea*, *Millericrinus escheri* Lor., *Apiocrinus*, *Pentacrinus*, *Balanocrinus*, *Plegiocidaris cervicalis* Ag., *Paracidaris florigemma* Phil., *Rhabdocidaris*, *Diplocidaris*, *Thiaris*, *Glypticus*, *Ostrea*, *Pecten*, *Lima*, *Cardium corallinum* Leym., *Pseudomelania heddingtonensis* Sow., *P. athleta* d'Orb., *Pseudonerinea clio* d'Orb., etc. The major part of these forms is characteristic of the Rauracian deposits of the Alps and Pyrenees, but younger forms are also encountered. The coral reefs at the base are apparently more ancient than the surrounding marls, thus causing the commingling of forms of different age.

2. Conglomerates composed of blocks and of finer pebbles with limestone lenses; in some cases they correspond to the

lower part of the Lusitanian stage and in others also include the Sequanian substage and the Kimeridgian stage.

3. The Callovian stage is represented by two facies: sandstones with interbeds of conglomerates composed of fine pebbles and shales of Mount Perchem — (*Hecticoceras hecticum* Rein., *H. rossiense* Teiss., *Phylloceras tortisulkatum* d'Orb., *Macrocephalites pila* Nik., *Peltoceras annulare* Rein., *Cosmoceras ornatum* Schloth., *Pecten, Lima, Gresslya truncata* Ag., *Coniomya proboscidea* Ag., *Rhynchonella alemaniea* Roll., *Terebratula sphaeroidalis* Sow., *Holectypus, Collyrites elliptica* Desm.) and argillaceous shales with interbeds of sandy and oolitic limestones, including a rich fauna of ammonites: *Hecticoceras lunuloides* Kil., *H. nodosum* Bon., *H. rossiense* Teiss, *Phylloceras, Ph. mediterraneum* Neum., *Ph. tortisulcatum* d'Orb., *Ph. viator* d'Orb. *Lytoceras adeloides* Kudern and *L. adelae* var. *crimea* Strem., *Macrocephalites macrocephalus* Schloth.

4. Middle Jurassic. Grey, argillaceous shales with iuterbeds of siderite nodules which only rarely yield ammonites *Oppelia aspidoides* Opp., *Phylloceras kudernatschi* Hauer, *Lytoceras adelae* d'Orb., and pelecypods: *Posidonia buchi* Roem., *Pecten.*

5. Tauric shales. Dark, highly dislocated shales, amongst which are present outcrops of igneous rocks and lenses of Liassic light-coloured quartzites. In the eastern Crimea country rock exposures of Lower Permian and Liassic limestones are absent, whereas Upper Jurassic conglomerates are here widely distributed and include (in some places in rather great quantities) water-worn blocks and pebbles of the above mentioned rocks.

In the region of Sudak are well displayed continental terraces, arranged in four stages. The upper (fourth) of these terraces is preserved in the form of several small table-mountains, the most northern of which reaches a height of 190 m. The third, Mandjil terrace is best developed at the southern foot of mount Mandjil (or Ai-Yori-dagh), about 185 km above sea level. The second, Perchem terrace, is located south-eastward of mount Perchem, and near mount Ai-Yori-dagh it is only preserved on small areas. Its absolute height is 36—90 m. The first terrace is present only in the western part of Sudak

and near the „German Colony". Besides continental terraces, in the vicinity of Sudak is also well developed a marine (Karangat) terrace, which is up to 12—14 m high. Its rocks rest unconformably on highly dipping Jurassic shales or abut against Lusitanian limestones and are overlain by continental argillaceous deposits of the second terrace. Its formation should most probably be assigned to the Riss-Würmian interglacial epoch, although up to now the problem of its age has not been solved.

The Sudak valley is built up of soft rocks — argillaceous shales and clays of Middle Jurassic and Callovian ages, marls of Lusitanian age, whereas the mountain heights of the environments are formed of compact limestones and conglomerates.

In the south-west, near the sea is situated cape Khuzkule-burun, built up of Lusitanian limestones; beyond them mount Sokol is visible, representing a syncline of the same limestones; in the north-west rises the anticline of mount Perchem, complicated by disruptions and consisting mainly of sandstones and conglomerates of Callovian and Lusitanian ages; in the north are visible the Taraktash heights, in the north-east mount Ai-Yori-dagh or Mandjil, in the south-east the Alchak cape projects into the sea; it separates the Kopsel valley from the Sudak valley.

From Sudak the excursion proceeds to Kopsel valley, where its members will study the Callovian and Quaternary deposits.

On the road leading from Sudak village towards the sea are present good exposures of ash-grey, sometimes darker, at others lighter, Middle Jurassic argillaceous shales and clays with partings of brown spherosiderites and marly nodules.

The road crosses the alluvial valley of the Suuk-Su rivulet and rises to the isthmus, connecting Mount Ai-Yori-dagh with cape Alchak, over argillaceous shales similar to those of Sudak. On the isthmus are visible two small table-mountains, the flat summits of which represent remains of the fourth, the most ancient terrace.

From the isthmus a view is obtained of the anticlinal Kopsel valley in the deep ravines of which are exposed Callovian and Middle Jurassic shales; the levelled surface of the hills is covered with alluvial cones composed of rubble of the third Mandjil terrace; in the south rises the Meganom syncline

built up of Lusitanian conglomerates; in the north is present a similar syncline of Ai-Yori-dagh.

Directly to the east of cape Alchak a rather low hill is present, on the summit of which occurs a stratum of dark grey, sandy limestone. This stratum begins at the very coast, dips steeply toward south-east and is traced up to the road, where it turns to the east. This limestone stratum is surrounded by argillaceous shales with thinner limestone and sandstone interbeds amidst which are distinguishable numerous yellow-brown spherosiderites and grey calcareous-marly concretions. To the east a continuation of the limestone stratum is present on Mount Kordon. Northward from the road there is traced a second stratum of similar arenaceous limestones. These limestones occur to the north-west of the above described hill, where they are overlain by a small area of Rauracian limestones with echinoderms and corals, on the hill to the west of the state farm and in the ravine westward of Mount Kordon.

The Callovian beds of the Kopsel valley lie conformably with the Middle Jurassic, thusp articipating in a rather complicated fine folding, whereas the Lusitanian conglomerates and limestones are torn off their base and show a gentler attitude. On the shore, between cape Alchak and Mount Meganom is situated a marine Quaternary terrace. Here are present marine conglomerates, limestones composed of shell detritus and looser shelly layers, including a rich fauna. On a line with *Ostrea*, *Mytilus*, *Pecten*, *Venus gallina* L., *Mactra*, *Donax*, *Cerithium*, *Nassa reticulata* L., *Tapes dianae* Loc. et var. *calwerti* Newt. which are living at the present time in the Black Sea, here are also encountered the extinct forms and species met with only in the Mediterranean Sea and the Sea of Marmora: *Pecten glaber* L., *Chlamys varius* L., *Cardium tuberculatum* L., *Venus verrucosa* L., *Ensis ensis* L., *Arca noe* L., *Cerithium vulgatum* Brug.,

After the return of the excursion from Kopsel to Sudak, it proceeds through the settlement „German Colony“ to the sanatorium „Noviy Svet“. On the road, at the bridge, over the brook are visible: in the eastoutcrops of Callovian sandstones, containing *Trigouia* and carbonized plant remains; in the west — the sharp peak „Sakharnaya Golovka“ consisting of Rauracian limestones. To the north of the road is widely developed the

second or Perchem terrace, the alluvial cones of which cover the summits of all the hills. It attains an altitude of 35—50 m.

The road borders the mountain and runs through the „German Colony". Westward of the latter there is a good exposure of light-grey Lusitanian marls, with a rich fauna of corals, sponges and echinoderms; these marls towards the south pass laterally first into stratified and then into compact limestones. Further on the road passes high above the coast, to the south of Mount Sokol.

At the place, where the road turns to the north and recedes from the coast are again exposed Lusitanian marls with rich fauna; on the sea coast there is present a marine terrace.

The sanatorium „Noviy Svet" is located in a very picturesque valley, surrounded by mountains. In the west near the sea rises a small mountain named Khoba-kaya and the spur of Mount Perchem-Sandykh-kaya, in the north — Mount Perchem and in the east — Mount Sokol.

Mount Perchem is an anticline complicated by latitudinal disruptions; on its southern and north-eastern slopes are exposed Lusitanian conglomerates whereas its main summit is built up of Callovian sandstones.

On the western and northern slopes of Mount Sandykh-kaya the Lusitanian conglomerates lie conformably with the Callovian sandstones, lower, from under the latter make their appearance highly crumpled Middle Jurassic shales and sandstones, and still further to the north crop out shales of Rhaetic-Liassic age. The more rigid Callovian and Lusitanian rocks are torn off their base and form gentle disrupted folds, whereas the lower-seated slopes consisting of softer rocks are highly crumpled.

The buildings of the sanatorium „Noviy Svet" are situated on the greenish-brown sandstones (resembling the Callovian) of the western slope of Mount Sandykh-kaya and of the summit Perchem.

The summit of Mount Sandykh-kaya is made up of Lusitanian quartz and calcareous conglomerates enclosing here the lens of limestone. The conglomerates dipping to the south grade into breccia-like compact and bedded limestones of Mount Khoba-kaya. A fine exposure of marls, with interbeds of thin-bedded limestones is present on the eastern slope of the above mentioned mountain, where

these marls contain great quantities of sponges, corals and echinoderms.

After its return to Sudak the excursion proceeds northward and crosses the Main Ridge of the Crimean Mountains between Sudak and Saly village. The road, from the sea, passes over the broad valley of the Suuk-su rivulet, which is built up of Callovian and Middle Jurassic shales. In the west a rather small hill rises, the summit of which is formed of Lusitanian conglomerates, including pebbles of Permian and Liassic limestones. Near Taraktash village there is a crest (the Artyshly-burun and Sary-kaya mountains) formed of Lusitanian conglomerates and of limestones almost standing on end. They constitute a steep syncline. Here the valley becomes distinctly narrower, but up-stream of the village it expands again and enters the region of development of the Tauric shales, forming a complicated anticline. The shales are highly crumpled into small folds, independent of the folding on a wide scale of the Upper Jurassic rocks. The road passes between Mount Biuk-Guba-Tepé and the Armutluk Range (a syncline of Lusitanian conglomerates) and emerges in the Suuk-Su valley made up of Tauric shales, amongst which are present outcrops of porphyrites and light-coloured Liassic quartzite-like sandstones. This valley is situated on the area of the anticline, the wings of which are formed of Lusitanian conglomerates, whereas the core — of Tauric shales. From the north the valley is flanked by limestones standing on end and containing *Paracidaris florigemma* Phill. and *Prodiadema agassizi* Roem. (Izmail-kaya and Chaplykh-kaya cliffs), further to the north are developed softer flysch rocks of apparently Kimeridgian age which terminate by a crest of calcareous conglomerate. Here the high-road rises to the pass of the Main Ridge and runs over a mountain valley towards the Elbuzly village, where are present light-grey clays and marls of Tithonian age, gently dipping northward.

Near the Kargalyk village clays of Valanginian age make their appearance, distributed up to Saly village, and the road enters the longitudinal valley, separating the Main Ridge from the Second. In the east lies Mount Agermysh which represents a fold of Kimeridgian limestones, sharply projecting among the Cretaceous rocks.

FROM SALY VILLAGE TO SIMFEROPOL

By G. WEBER

Between Saly village and Simferopol the excursion studies both the longitudinal valley separating the Main Ridge from the Second and the southern slope of the latter with Cretaceous and Lower Tertiary deposits developed here.

The valley of the Indol River, where Toply, Kishlav and Saly villages are located, is built up in its southern part of Valanginian, Hauterivian, Barremian and Aptian plastic clays, and in the north of Albian marly clays with interbeds of sandstone and Upper Cretaceous marls. In the north-west rises the Second Ridge of mountains (Kuvalach, Kulyaba and Bor-kaya); at its base are exposed Upper Cretaceous and on its summit — Paleogene strata, in the south extends the Main Ridge, built up of Upper Jurassic flysch rocks and limestones.

Near the rest home in the former monastry of Toply are developed Lower Cretaceous conglomerates and sandstones which pass gradually into the flysch deposits of Mount Taubashi referred to the Tithonian.

Westward of Toply village there is a hill consisting of Lower Cretaceous conglomerates, which include blocks of Paleozoic sericite schists of several meters in diameter.

In the valley of the Indol River, to the south of Mount Kuliaba, are developed Albian clays, at the foot of the mountain occurs a white breccia-like limestone of Upper Turonian age with *Inoceramus lamarki* Park., resting upon the light-coloured greenish-grey clays of the „Vraconnian" containing

Aucellina gryphaeoides Sow. and *Noehibolites* ex gr. *ultimus* d'Orb. The Upper Turonian and Cenomanian deposits are absent here. Higher along the slope crop out Senonian marls and the Danian and Paleocene arenaceous limestones. On the summit of Kizil-kaya occur Middle Eocene deposits bearing a flysch character with a limestone interbed containing small nummulites; these deposits resemble those of Theodosia.

In the west Mount Kuliaba is separated from Mount Kuvalach by a considerable horizontal dislocation in meridional direction, and the Senonian marls of the latter mountain abut upon Lower Cretaceous conglomerates of a small mountain and located at Toply village. Mount Kuvalach situated westward of the dislocation displays a full section of Upper Cretaceous beds.

1. Paleocene. Light-coloured, greyish, compact limestones with *Pycnodonte montiensis* Br. et Corn., *Exogyra eversa* Desh., constituting the summit of the mountain.
2. Danian. Compact yellowish marls with echinoids.
3. Upper Maastrichtian. Arenaceo-marlaceous limestones of the zone *Belemnitella americana* Mart.
4. Lower Maastrichtian. Marls with *Belemnitella lanceolata* Schloth. and *Scaphites constrictus* Sow.
5. Campanian. White marls with *Belemnitella mucronata* Schloth. and *Inoceramus* shells.
6. Santonian and Coniacian. Marls with a poor fauna,
7. Upper Turonian. Limestones wtth *Inoceramus lamarki* Park.
8. Lower Turonian. Silicceous marls.
9. Cenomanian. Greyish-yellowish, arenaceous marls with *Inoceramus cripsi* Mant., *In. etheridgei* Woods.
10. Albian. Green glauconite sandstones with *Aucellina gryphaeoides* Sow., *Neohibolites minimus* List., *Neohibolites ultimus* d'Orb.

The valley of the Indol river here again expands and from under the Albian deposits, on its right slope, appear the Aptian, Barremian, Hauterivian and Valanginian clays, resting on the flysch deposits of Tithonian age. Kimeridgian limestones of Mount Topshan are thrust over them from the south.

At the southern end of Mount Kuvalach the road traverses first the Aptian and further the Hauterivian and Valanginian clays and turns to the north-west, bordering the spur of the Second Ridge.

Owing to meridional dislocations the Lower Cretaceous conglomerates appear anew at the Urus Khodja village.

From the basin of the Indol River, the road enters the valley of the Kuchuk-Karasu River. At the Bakhchi-eli village are exposed Aptian clays. Driving past the orchard situated on the alluvial terrace of Kuchuk-Karasu River, the excursion arrives at the Second Ridge, at the base of which, near Katyrsha-sarai village, can be seen the lower portion of the slope built up of Aptian and Albian clays. At the entrance to Kaburchak village

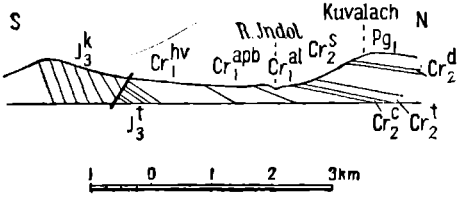

Fig. 10. Schematic Profile across Mt Kuvalach.

Pg_1 — Paleocene; Cr_2^d — Danian; Cr_2^s — Senonian; Cr_2^t — Turonian; Cr_2^c — Cenomanian; Cr_1^{al} — Albian; Cr_1^{apb} — Aptian-Barremian; Cr_1^{hv} — Hauterivian-Valanginian; J_3^t — Tithonian; J_3^k — Kimeridgian; / Fault.

Upper Turonian limestones are present, whereas the village itself lies on Lower Senonian marls.

In the escarpment of the Second Ridge — on Mount Ailianmakaya the following section has been established.

1. Eocene. The northern slope of the mountain is occupied by white nummulltic limestones of the Lutetian stage; with large nummulites; at the base of these limestones occurs a bed of glauconite sandstone with *Nummulites irregularis* Desh., *Assilina exponens* Sow., *Discocyclina*.
2. Paleocene. Hard, compact semi-crystalline in places porous, white or yellowish limestones with casts of gastropods and pelecypods; they form the summit. Thickness—25 m.
3. Danian stage. Yellowish Bryozoa limestones, characterized by honeycomb weathering. Thickness—5 m.
4. In the lower part of the mountain crop out yellowish, sometimes more compact, at other places soft marlaceous sandstones with glauconite, which include a great quantity of

oysters *(Pycnodonte similis* Pusch*)* and echinoids *(Echinocorys sulcatus* Goldf., *Micraster* sp.) and but seldom are encountered *Hercoglossa danica* Schloth. At the base occurs a stratum of loose glauconite sandstone with phosphates and great quantity of pectinids and *Equipecten meridionalis* Eichw., *Alectryonia ungulata* Schloth., *Al. lunata* Nils.

5. Maastrichtian. A marlaceous sandstone of the zone *B. americana* Mart., which already forms a gentler slope.
6. Lower occur marls of the zone *B. lanceolata* Schloth. and *Scaphites constrictus* Sow. of slightly yellowish colour, containing a rich fauna of pelecypods and gastropods.
7. Campanian. At the base occur white marls with *B. mucronata* Schloth., *Inoceramus balticus* Soehm. and sponges.

Further east, on the Burunduk-kaya mountain the thickness of the lower part of the Danian stage (sandy marls with

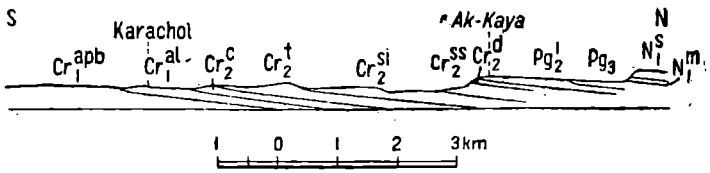

Fig. 11. Schematic Profile between Karachel Village and Mt Ak-kaya. N_1^s — Sarmatian; N_1^m — Mediterranean beds; Pg_3 — Oligocene; Pg_2 — Middle Eocene; Cr_2^d — Danian stage; Cr_2^{ss} — Upper Senonian; Cr_2^{si} — Lower Senonian; Cr_2^t — Turonian; Cr_2^c — Cenomanian; Cr_1^{al} — Albian; Cr_1^{apb} — Aptian, Barremian.

echinoids) significantly increases, whereas the bryozoary limestone is only preserved in the form of a layer of 1—2 m in thickness. Still further the bryozoary limestone totally disappears. In the west is clearly distinguishable the transgressive attitude of the nummulitic limestones: on Mount Adjilar they rest on the Danian beds, on Mount Ak-kaya — on the Maastrichtian arenaceous marls of the *B. americana* zone, and further to the west — on the Lower Maastrichtian, Lower Senonian and Turonian.

Southward the road crosses the Lower Senonian and Turonian marls, the chalk-like rocks with interbeds of flint, and leads to town Karasubazar.

This small town is an administrative centre. It lies on Cenomanian marls, containing a rather rich fauna. Here were found:

Schloenbachia varians Sow., *Acanthoceras mantelli* Sow., *Puzosia subplanulata* Schl., *Turrilites tuberculatus* Bosk., *Inoceramus cripsi* Mant., *In. etheridgei* Woods., *Aucellina gryphaeoides* Sow., *Neohibolites ultimus* d'Orb. etc.

In the vicinities of Karasubazar are very well developed Quaternary terraces, which at places attain a thickness of 10 and more meters. Four terraces are distinctly traced and in places two transitional terraces can be observed. The first and second terraces are built up of loams and pebble beds, the third — of thick cemented conglomerates.

From Karasubazar the excursion proceeds south-eastwards in order to study the Lower Cretaceous deposits. Near Sarysu village begin the Albian marlaceous clays with sandstone interbeds, and at Alexandrovka village — the dark Aptian clays with spherosiderites, *Neohibolites semicanaliculatus*. Bl., *N. aptiensis* Kil., *Mesohibolites unligi* Schwetz. etc.

Further south, at Taigan village, the clays yielded small, pyritized Barremian and Hauterivian ammonites.

To the north-west of Efendi-koi village the Aptian clays are overlain by Albian conglomerates including water-worn Barremian ammonites, similar to those of Bia-saly village and Sably.

To the south of Argin-Baksan valley begin the northern spurs of the Karabi-Yaila Range, consisting of Tithonian marly limestones with corals, *Itieria rigufera* Zitt. and other fauna. These beds are broken by a number of dislocations in meridional direction the western wings of which are downthrown. In the Argin-Baksan valley the argillaceous deposits are replaced by more shallow-water facies consisting of sandstones and limestones. At Baksan village there is the following exposure.

1. Urgonian. Light-grey limestones with gastropods and rudists: *Nerinea bicarinata* Pč., *N. upensis* Vogdt, *N. angustata* Pč., *Leviathania borissiaki* Pč., *Triptyxis belbekensis* Vogdt, *Ptygmatis neusatzensis* Vogdt, *Diazoptyxis markoui* d'Orb., *Procerithium burulčensis* Vogdt.
2. Hauterivian. Thin-bedded marly limestones with sponges, echinoderms, brachiopods and pelecypods *Magnosia camarensis* Lor., *Peltastes stellulatus* Ag., *Acrocidaris minor* Ag., *Rhabdocidaris buraganensis* Web., *Diplocidaris*, *Cidaris*, *Rhynchonella multiformis* Rœm,, *Terebratulina arglnensis* Vogdt, *Terebratula* cf. *depressa* Vogdt, *Lima dubi-*

siensis P. et C., *Anatina gurguitis* P. et C., *Pharomytilus gillieroni* P. et C., *Septifer lineatus* Sow.

3. Valanginian. Greenish-brown glauconitic sandstones with ammonites, pelecypods and gastropods: *Acanthodiscus* ex gr. *malbosi* Pict., *Negreliceras negreli* Math., *Spiticeras arginensis* Vogdt, *Berriasella smielensis* Pom., *B. terenairensis* Zebr., *Gervilia alaeformis* Sow., *Cuculaea.*

To the north the Urgonian limestones wedge out and the whole series of Lower Cretaceous deposits, from Valanginian to Barremian, is represented by glauconitic sandstones.

These sandstones are overlain on the right bank of Montanai ravine by Albian conglomerates and then by Cenomanian marls over which passes the road up to Zuya village. To the north of the road again appears a zone of Lower Cretaceous deposits which due to folding is complicated by fractures. To the west of the Zuya village on the road the Eocene nummulitic limestones forming the summit of the Second Ridge rest on the Lower Cretaceous sandstones, afterwards on the Cenomanian marls and at Kayasta village again on the Lower Cretaceous sandstones.

On the nummulitic limestones of the Second Ridge east of Zuya village Sarmatian is clearly observed resting over various horizons of the Cretaceous and Paleogene. The Third Ridge is absent here.

From Zuya village the road passes the watershed between the Zuya River and the Beshterek mountain. Following nummulitic limestones Upper Eocene marls appear in Beshterek valley, the road running over them up to Simferopol. Only here begins the Third Ridge built up of Neogene rocks (Sarmatian and Mediterranean beds) being underlain by Upper Eocene marls.