С С С Р
/О "ТЕХНОЭКСПОРТ"

онтракт № 640
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КОРОЛЕВСКОЕ ПРАВИТЕЛЬСТВО
АФГАНИСТАНА

МИНИСТЕРСТВО ГОРНЫХ ДЕЛ И
ПРОМЫШЛЕННОСТИ

Михайлов К.Я.
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О Т Ч Е Т

о геолого-съёмочных работах на каменный уголь масштаба I:200.000

Часть I

Герагская провинция
/части листов I-4I-IX, -X, -XI и XYI/

Главный специалист
В/О "Техноэкспорт" СССР
О.А.МАНУЧАРЯНЦ

Кабул, 1965 год

V/O "TECHNOEXPORT"
U S S R
CONTRACT No.640
OF 24 Nov.,1962

ROYAL GOVERNMENT OF
AFGHANISTAN
MINISTRY OF MINES
AND INDUSTRIES

K.Mikhailoff
V.Kulakoff
V.Kolchanoff
B.Pashkoff

R E P O R T

OF GEOLOGICAL SURVEY WORKS FOR COAL.

SCALE I:200.000

PART I

HERAT PROVINCE

/sheet parts I-4I-IX,-X,-XI and XVI/

Chief specialist of
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K A B U L , I965

ANNOTATION.

In accordance with the work programme, foreseen by contract No. 640, geological survey investigations in Northern Afghanistan were conducted in two regions: in the Herat province and in the provinces of Samangan, Baglan and Bamian.

The present " Report of geological works for coal / part I/" deals with the results of the field investigations in the Herat province, carried out in the summer of I964. The works were carried out by two geological survey crews at a scale of I:200000. The survey covered the region of 3400 km^2 in area, situated 30 km north-east of Herat and extending further to the east for 70 km.

"The Report ... " covering 294 pages has a widened explanatory memorandum to the geological map at a scale of I:200000/ made on the topographical base on a scale of I:I00000/. The report is accompanied by all the necessary graphical annexes/ see " Contents"/; 58 illustrations are given in the text. All the necessary informations of the geological structure of the territory, manifestations and deposits of useful minerals are contained in 8 chapters.

In connection of singleness of the purpose of the carried out investigations / prospecting-survey works for coal/ detailed informations of all the investigations in the process of prospecting-survey works, deposits and manifestations of coal / Chartaq, Pahlawanha, Madjed-i-Chob-i/ are contained in the report, the results of coal petrographical and other laboratory works are given.

In connection with the fact that the geological and other maps are made in English, the report contains an index of geographical names in Russian and English, and a Russian text to conventional signs and the summary stratigraphical column.

The Russian text contains references to the figures. The explanations to these figures are given at the end of the report.

C O N T E N T S

4. SKETCH TECTONIC MAP, SCALE I:300000 . . . I sheet

5. GEOMORPHOLOGICAL MAP, SCALE I:300000 . . . I sheet

6. GEOLOGICAL SKETCH MAP OF THE MADJED-I-CHOBI COAL DEPOSIT, SCALE I:25000 . . . I sheet

Note: Maps Nos. 4&5 are in the report text.

I N T R O D U C T I O N .

The geological survey works for coal on a scale of I:200000 were carried out in accordance with contact No.640, concluded on the 22nd of November,1962 between the Vsesojuznoje export-import Objedinenije of the USSR /"Technoexport"/ and the Ministry of Mines and Industries of Afghanistan on the grounds of the agreement between the USSR and the Kingdom of Afghanistan, of the I6th of October, I96I.

The survey area of 2900 sq.km in the Herat region was planned by the Geological and Mineral Survey Department of the Ministry of Mines and Industries of Afghanistan, which was reflected in the work project, compiled by the Soviet specialists and confirmed by the Authorities of the Department in June,1963/fig.I/.While fixing the boundaries of the prospecting survey area the Geological and Mineral Survey Department had the informations of three coal manifestations within the limits of this area / Čortak,Pahlawahna and Majed-i-Čobi/, situated near Herat. There are no geological map of this area , compiled before.

According to the project the geological survey and prospecting works were to be conducted here in I965. In fact, According to the subsequent principal of the Ministry of Mines and Industries , they were fulfilled one year earlier than the time fixed in the project,i.e. in the period from the 25th of May up to the 20th of July,I964.

The volumes of the fulfilled field works are given in the following table:

No.	KINDS OF FIELD WORKS	unit of measure	VOLUMES	
			BY PLAN	fulfilled in fact
I.	GEOLOGICAL SURVEY ,scale I:200000	sq.km	2900	3400
2.	HEAVY CONCENTRATE SAMPLING	sample	450	609
3.	Spectral sampling	sample	550	II00
4.	HYDROCHEMICAL SAMPLES	sample	30	38
5.	MINING WORKS / trenches, strippings,etc./	cub.m.	225	230

The works were conducted by two geological survey crews. On the Afghan part: the chief of the crew-Munchezada,the engineeer-geologist-Rustami-Shafi,collectors-Ibraim,Usman and Izmail. On the Soviet part:the technical instructor-K.Ja. Mikhailoff,engineer-geologists-V.V.Kulakoff,B.N.Androssoff,V.P Kolchanoff,B.P.Pashkoff, senior technician-geologists-A.I.Goreloff,V.M.Kotoff,A.G.Gumeroff,the interpreter-F.I.Alekperoff.

The field works were carried out on the topographic base on a scale of I:I000

published in 1960/USSR/ quite satisfying all the necessary requirements. Aerophotos at a scale of 1:60000 of all the studied territory were used while working.

Trips were conducted mainly on horses, partly in cars and on foot. The total extent of the trips is 1530 l.km or 0.5 l.km for I sq.km of the area; A total of 2308 stations or 0.76 for I sq.km of the area.

The prospecting works were of the complex character by the used methods and by the kinds of minerals.

Different determinating works were fulfilled in the laboratory of the Geological and Mineral Survey Department in Kabul and partly in the USSR.

Material treatment and writing of the report chapters were distributed among the geologists and other specialists in the following way:

-Middle Paleozoic,Lower-Middle Carboniferous and intrusive rocks-V.V.Kulakoff.

- Permian System and Turkestanian stage- B.R.Pashkoff;

- Cretaceous System , Paleocene,Suzak and Alaian stages -V.P.Kolchanoff;

- Characteristic of underground waters -G.I.Kulinich-senior hydrogeologist of contrac No.640;

- Orographic assay- M.A.Chalian;

- Heavy concentrate sampling- A.I. Goreloff;

- All the rest chapters and sections and general editing of the report-K.Ja.Mikhailof

- coal petrographic investigations are made by M.A.Marshanskaia/Judina/;

-petrographic determinations of thin sections are partly made by the senior petrograp er I.A. Efimoff /Kabul/- about 15%/.

- mineralogical analyses are made by E.I.Mikhailova and E.A.Narodnaja/Kabul/.

- Chemical analyses/ silicate and of minerals / are made by the analysts A.N.Trofimova,M.I.Scherbina,I.B.Kondratieva,M.P.Zhukova/Kabul/;

- Technical analysis of coal is made by L.M. Andreeva;

- Spectral analyses are made by Ju.L.Skaller /Kabul;/

- Determination of flora fossils -T.A.Sixstel and N.M.Losseva /USSR,Tashkent/;

- Determination of fauna fossils -B.K.Kushlin ,A.A.Shevirieff,T.V.Shevchenko,N.V.Litnovich,I.V.Pizhianoff,V.V.Drushits,A.S.Dagis,V.L. Lelishus,S.S.Karapetoff /USSR,Mosc Dushanbe/;Kuznetsoff B.I. /Afghanistan,Mazari-Sheriff/;

- Graphical annexes in the text are made by V.M.Kotoff;

- Graphical annexes in attachments /geological map and mineral resources map/ are made by A.P.Vassilieff and R.A.Vassilieffa /Kabul/.

- Photos are made under competent direction of V.L.Kurtseff /Kabul/.

General organizing-methodical direction of the works in the field and office periods was realized by the Chief specilist of contract No.640 -O.A.MANUCHARIANTS and the Chief geologist -JU.N.LAVROFF on the Soviet Part.

Mr.MIRZAD ,the President of the Geological and Mineral Survey Department dire ed the works on the AFghan part.

Chapter I. GEOGRAPHICAL DESCRIPTION OF THE REGION.

RELIEF. The region is situated within the limits of the mountain country of Paropamiz, covering not fully its northern part, known as Safed Koh.

Across the whole territory ,approximately in the middle of it,the ridges Selsc Koh-i-Band-i-BAba,Koh-i-Zarmast and Band-i-Badgisat, which are the main rangesof the mentioned mountains. The western part of the ridge Band-i-Badgisat has the local name -Hoja-ABdol/fig.2/. Their watershed parts are located at elevations of 2500 to 3000 m. The highest mark /3128/ is in the central part of the ridge Band-i-Badgisat. Reference elevations are 600-700 m. The medium-high-altitude mountains of the mentioned ridges are characterized by comparatively flattened ,slightly dismembered watersheds. The relief of stepped plateaux and table mountains are often typical of them. The ridges slopes are sharply dismembered and precipitous in most cases.

In north-west of the region the northern slopes of the ridge Selsela-Koh-i-Band i-Baba up to 800 m in height are of the precipitous-stepped character, then they gradually turn into a hilly-ridgy surface , highly broken, gently lowering northward to the valley of the Kuśk. The south-eastern part of the territory is occupied with the mountain massif Koh-i-Diwandar-a large spur of the mountains Safed Koh. Its main ridge elongates from south-west to north-east, forming a watershed of the Harirod and its right tributary-the Karukh.They are also medium-high-altitude mountains with bench marks from 2500-to 3500 m and reference elevations of 800m at an average; in some cases the latters reach 1300m. Steep slopes and narrow, sometimes saw-like crest are typical of them. The mountain sections of the region are characterized by good exposure.

Some intermontane areas of different origin are in the described territory.The largest of them is the Karukh one, which is situated between the ridges Koh-i-Dawindar / in the south/ and Selsela Koh-i-Band-i-Baba / in the north/.Its depth is about 50 km, the largest width -10 km. The sides of the mountain area are gentle, in section it has a cup-like form./fig.3/.

A small mountain area,which is called the Laman one, is situated in the north-east of the area, Its length is about 25 km, its width -5 km. Its resembles $\frac{n}{a}$ ellips elongated in a meridional direction. Stepped, sharply dismembered slopes,surrounding it from all the sides, give it a pictureeque look.

Besides, an inconsiderable part of the Harirod mountain area, situated south of the investigated region, is within the limits of the territory.

RIVERS. All the rivers of the region appertain to the systems of two long rivers- Harirod and Murghab, flowing beyond the limits of the investigated territory. Sharp change of discharge, depending on the season, is typical of the region rivers, because the main quantity of moisture, they receive, is due to precipitations.

The Karukh river is the longest one in the region. Its length is 80 km. It flows across the whole territory from north-north-east to south-south-west and falls into the Harirod river beyond the limits of the area. The Karukh r. sources are on the southern slopes of the ridge Band-i-Badgisat and on the northern slopes of the ridge Koh-i-Dawindar. In its upper reaches the river has a narrow valley with steep sides. In the lower and middle reaches within the limits of the Karikh area, the valley sharply widens. The river meandrizes here, often in the period of high water it changes its river-bed. The main tributaries of the Karukh river are Rod-i-Maluma, left, about 35 km long; Rod-i-Darakht-i-Tut and Darra-i-Chartaq, right, 20 and 25 km long correspondingly.

Short tributaries of the Harirod river originate on the southern slopes of the ridge Koh-i-Dawindar. The largest of them are Darra-i-Maghozar and Tagab-i-Jari. They are water-bearing periodically and episodically.

The rivers of the basin of the Murghab, situated on the studied territory, are its left tributaries. The main of them are the rivers Darya-i- Kushk with the tributary Darya-i-Gala-Chaghar and Darya-i-Tagab Laman.

The rivers Darya-i-Kushk and Darya-i-Gala Chaghar originate on the northern slopes of the ridge Selsela Koh-i-Band-i-Zarmast and Band-i-Badgisat. The length of each of them is about 50 km. They flow in narrow and steep valley sides, widening only in the lower reaches.

The river Darya-i-Tagab Laman, about 40 km long, originates on the northern slopes of the ridge Band-i-Bangisat and flows northwards along the Laman mountain area. Considerable part of moisture is brought from springs and that is why the river does not dry completely even in summer.

Numerous small channels, flowing from the northern slopes of the mountains Safed -Koh, carry their waters into the Murghab river, besides the above mentioned

CLIMATE. x/ The climate of the investigated territory is sharply continental Hot dry summer and short comparatively cold winter with little snow are typical of it. The highest temperature in July is up to +45° C. The lowest temperature in Jan

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x/ The description is based on the data of the Herat meteostation/ observations of 1960-1961 and 1964/, situated in the Harirod valley at an altitude of 940m above sea level, 40 km south-west of the work region.
The investigated territory is 1000-1500 m above the station. There may be some lowering of the average annual temperature and increase of precipitations quantity, mainly due to snow. / in relation to the mentioned below data//

nuary is down to -13°C. The average July temperature is +31°C, the average January-one is +3°C /fig.4-I/. I90mm of precipitations fall during the year /fig.4-II/, mai ly as a rain . From 40 days in the year with precipitations only two -three days ar with snow. The main amount of precipitations falls in February-April. The hottest s son is August and September, when relative moisture lowers down to44%, with the ave age moisture during the year -70%. From May to September during I20 days north-weste winds blow.They carry aridity and intense heat.The climatic conditions make artifi cial irrigation necessary.

VEGETATION. The region vegetation is not various. The northern slopes of the ridge Koh-i-Band-i-Baba abd Band-i-Badgisat are covered with sparse growth of trees in contrast to practically woodless mountains of Koh-i-Dawindar. Plants, represente by pillow-like plants- hedge-hogs,are widely developed.In foothills one can see dese vegetation:wormwood,burr,etc.The vegetation of river valleys is more various; where poplar, plane/tree/,sweetbrier,barberries,blachberries.Near the settlements ,situate in the river valleys, fruit [illegible] gardens, vineyards, kitchen gardens, sowing areas o cereals are usual.

POPULATION AND ECONOMICS. The work region is densely populated. Most settlement are situated along the river valleys or near springs. The main occupation of the popu lation -afghan peoples-cattle breeding and agriculture, based mainly on artificial ir rigation.The single half- handicraft production within the limits of the investigate territory- coal exploitation near the settlement Madzhed-i- Chob-iw

MEANS OF COMMUNICATION. The main highway is Mazar-i-Sherif and Herat. Within th work region the highway lies along the Karukh valley, then over the pass Kotal-i-Sabza /24-98m/, descends in the Darra-i-Laman valley. At all its extent the highway has no asphalt, which makes traffic during 3-4 most rainy months difficult.The Sabzak -Kotal is dangerous for lorries. There are three branches of the main highway. One-in the direction of the settlement Maluma/5 km/;Traffic of any cars is possible by this road A second one- in the direction of the Kotal-i-Zarmast to the settlement Tagau Robat /I6 km/;the road is fit to passage of cars "GAZ-69". A third one- from the place,Jar-Mosh Rofan [illegible] via the settlement Hamam to the coal deposit of Madzhed-i-Chobi,the roa is fit for traffic of any cars during the whole year.

The local dwellers use also numerous trails and pack paths [illegible] as means of conve ance. The heights of the constantly acting passes in the region do not exceed 2700 m.

Chapter II. GEOLOGICAL STUDYING OF THE REGION.

The earliest geological investigations in Afghanistan, which kept their import-ance up to now, were conducted by K.Griesbakh/I88I-I887/. These investigations were o

the reconnaissance character and partly covered the region, studied by us. C. Griesbak pointed out "neo Devonian" for the first time, the he determined them as Carboniferous beds in the mountains Selsela Koh-i-Dawindar. He distinguished the limestones "Jawza" of supposedly Jurassic age/ as a result of our works their age was determined as lower middle Triassic/. In immediate proximity to the region of our works he described the beds "Palezkar" /P?-T?/, wich are ,probably, of Triassic age. Black schists of Jurassic age are described in the valley of Rod-i-Karukh, in the hills of Hol-i-Biaz /the northern slope of the ridge Selsela Koh-i-Dawindar/. However, the determinations of fauna or flora did not confirm the age of these deposits. We have not works K. Griesbakh /I884/ attaches great importance to the description of coarse red sandstones /Red grits/ which were ascertained by him for the first time in the region of Herat and were attributed to Lower Cretaceous. The sections were described between Sang-i-Anjil and Holi Biaz, Band-i-Baba and Rabati-Hana, at the pass Chashmasales and in other points, the part of which is situated on the territory, investigated by us. J. Barth oux /I933/ doubted the same age of the group of "Red coars-grained sandstones" of the Herat region and the deposits of the same facies of the eastern Hindu -Kush. Later on H. Gizancourt /I937/ and his collegues proved that some beds in Band-i-Baba, attributed by G. Griesbakh to the group of red coarse-grained sandstones" are younger /probably, Senonian/.

Our investigations, as that will be mentioned in the present report, confirmedh the doubts of J. Barth oux and G. Gixancourt. The deposits of the group of 2red coarse grained sandstones", as they are understood by G. Hyden /I9II/ and other authors, are absent in the region, invostigated by us. K. Griesbakh, and then S. Tromp and others attributed the deposits of the Permian and partly of Danian-Maastrichtian age to thes these deposits, which are similar to the former by colouring and composition.

Later on S. Tromp and S. Popol /I954/ crissed the region, investigated by us, with a geological trip along the road Horat-Kalai-Nau /fig. 5/. Between the points, situated 10 km south of Kalai-Nau and 50 km east Herat S. Tromp described the sections of the series of the type "red coarse-grained sandstones" which appertain to red deposits of the Permian age in fact.

At the Pass Sabzak S. W. Tromp dexcribed the series "Sabzak" /Lower Cretaceous-Oligocene?/, composed of tuffs, red gypsum-bearing clays, red sandstones and conglomerates, with the totel thickness of over 60 m. S. W. Tromp did not find fauna in these deposits and the age was ascertained on the grounds of the lithological likeness with the Oligocene rocks of the Elbrus in Iren. According to S. W. Tromp, these deposits overlie the series "Kalai-Nau" of the Senomanian age /probably, identical to the Senomanian "limestones- coquinas of Kalai-Nau", distinguished by C. L. Criesbach in I885 north of the region, investigated by us/ and are overlain by Pliocene deposits of the series "Turkoman" /gray and brown marls, underlain by conglomerates and turning

into loesses over/.

As a result of our investigations we could not confirm the sequence, described by S. Tromp. We observed red deposits with gypsum / but without tuffs/ and described t them here together with the Upper Cretaceous sequence / Maastrichtian-Danian/. They overlie the Senonian limestones and marls, distinguished by S. Tromp as the series Kalai-Nau. As to the series "turkoman", the loesses, described by the mentioned author in the composition of this series and on the pass Sabzak and west in the valley Rod-i-Karukh,are not the sediments of the Pliocene age,but appertain to the Upper sequence of the Quaternary system.

In I950 D.M. Lemmon conducted the investigation of the Madjed-i-Chob-i coal deposit. The geological conditions of this area are described by him rether generally. In outline thei coincide with out ideas of the region structure. D.M. Lemmon thought that there was one coal seam in the deposit. In fact, we ascertained two seams in different strata. The practical evaluation of the deposit by Lemmon is somewhat understated, which is. probably, connected with a very limited volume of the fulfilled works at the deposit.

In I958 Paul D. Hammer investigated the Palawan coal manifestation and those of Chartaq and Madjed-i-Chob-i . There are no data of stratigraphy and structure of these areas in his report. The coal manifestations themselves are described very superficially. Paul D. Hammer considered the coal manifestations of Palawan and Chartaq not interesting from the economical point of view. In this respect his conclusion fully coincides with ours.

In I960 the Soviet geologists S. Ivanoff,V.Kulakoff, E.Kulaeff and O.Tcherkesoff ?i96I/ made geological survey on a scale of I:50000 in the region of the ridge Band-i-Gandao to expose oil bearing structures in the region on the instructions of the Oil Department of the Ministry of Mines and Industries of the Kingdom of Afghanistan. The area of the survey adjoins the region of our investigations in the south.

Some stratigraphic sequences, for example, the sequence of Cretaceous deposits, made by O.Tcherkasseesov in the region of Hoja Shahab is situated in the northern part of the territory, investigated by us. The Paleozoic deposits are described by us shortly,as they were not a subject of special studying. The Triassic deposits are not distinguished. They are, probably, united with the Jurassic ones in the region of the pass Kota-i- Sabzak, because the thickness of the latters is in four times over than that, which was ascertained by us at detailed studying of this region. As to the sequences of Cretaceous and Paleogene deposits, they are composed sufficiently in detail and the sequence at Haji-Shahab is taken by us as the base one for this region only with some corrections. The examination of the list of fauna by V. Kuznetsoff, paleontologist/ concerning the lower part of the Cretaceous sequence/, and also our gathering fauna did not confirm the Aptian stage, which had been

distinguished here before, though some elements of which are not completely excluded. The Maastrichtian deposits are divided somewhat differently. The Maastrichtian stage /marls, limestones/ and separately the Maastrichtian-Danian stage / red sandstones, conglomerates, clays, limestones/ are distinguished by us due to the erosion and interruption in sedimentation, seen in the whole investigated territory.

In the same I960 the Soviet geologists Ju.P.Chepoff, E.V.Bazanoff and A.I.Shelomentseff /I96I/ conducted geological survey works on a scale of I:500000 to expose the perspectives of oil presence of this territory for the Oil Department.The area, surveyed by them, covers the northern part of the region, investigated by us. Little attention is drawn to the deposits of the Paleozoic group in the report of these works as well as in the report by S.D.Ivanoff. The sediments of the Permian group are distinguished as a stratigraphic analogue of the Amanbulak suite of Tuarkir /USSR/. We do not consider that incorrect,but still we do not compare them as there are no sufficient proofs for that. The coal-bearing deposits near the pass Sabzak are dated as Triassic Their thickness is overstated more than in three times because of joining the Triassic to them, which was not distinguished in this region by the investigators. As to Cretaceous and Paleogene deposits, their dismembering coincides with that taken by us, for example, for the Laman region, with the exception of some details, concerning the thicknesses of separate subdivisions / for example Cr_2 cn+st+cp, and also Pg^2_2 a/and boundaries / for example between Cr_2 cn+st+cp and Cr_2 m/. As to structure of the region, we should say about the Laman nose which hardly existed as an old /pre-Cretaceous nose ,according to our opinion. At the same time a gentle uplift, into which all the Mesozoic and Paleogene deposits were included, appeared in the Alpian structure in the region of Laman.

Chapter III. STRATIGRAPHY.

The deposits, composing the studied territory, are very different in age, composition and facies. The deposits of the Middle Paleozoic, the Lower and Middle Carboniferous,the Permian sediments, the deposits of the Triassic system, of the Middle section of Jurassic, Lower and Upper Cretaceous ,Paleogene and Neogene, and also the Quaternar formations of different genetic types are present.

The possibility of studying these deposits and their dismembering on more fractional stratigraphic subdivisions was different due to their uneven distribution as well as due the peculiarities of the facial character.

Thus, the deposits of the Middle Paleozoic were studied slightly and were not dismembered more fractionally due to their unwide distribution on the studied area, lithological monotony and the absence of organic remains.

The terrigene red deposits of the Permian system were very difficult for studying and dismembering due to the absence of fossils in them, general monotony and inconsistency of separate bands and beds, though the area, composed of these sediments is rather sparce, as one can see from the attached map.

On the contrary, the deposits of the Triassic, Cretaceous and Paleogene systems are very various, comparatively rich in fauna remains and in most cases they are dismembered in to stages and suites.

The Quaternary deposits on the studied territory were dismembered minutely for the first time. Their age correlations are based on the geological-geomorphological features and are not confirmed by organic fossils or the remains of peoples' cultures.

The places of distribution of particular stratigraphic sections, below described, and also given as columns, are shown under the corresponding numbers on the scheme, represented on fig.6.

PALEOZOIC GROUP / Pz /.

Within the limits of the studied territory the Paleozoic deposits are developed rather widely. They compose the ridges Selsela Koh-i-Band-i-Zarmast, Selsela Koh-i-Dawindar and the southern versants of the Selsela Koh-i-Band-i-Baba and Band-i-Badgisat. Stratification of the Paleozoic deposits is connected with great difficulties due to complex conditions of their bedding and comparative rarity of determinable fossils. They are divided by us in the following way according to their lithological features and on the grounds of the fossils of fauna remains /upwards/:

I. Middle-lower Paleozoic subgroups /Pz_2-I /- non-divided deposits:

2. Carboniferous system / C/, divided into two suites:

   a/ Palawan / C_1pl/ and

   b/ Sangizard / C_2Sn/.

3. The Permian system is divided into three strata on the section and in the text: red-brown, lilac-gray and dark-red. On the geological map these strata are not distinguished due to vagueness of their boundaries.

Besides, non-dismembered deposits of the Permian system and the Triassic system are distinguished by us/ Permian-Triassic, P-T/.

MIDDLE - LOWER PALEOZOIC / Pz_{2-I}/

The middle-lower paleozoic deposits are spread in the southeast of the studied territory at an area of about 100-110 sq. km. They crop out in the eastern part of theSelcela-Koh-i-Dawinar, where they compose a core of a large anticline. These rocks are traced at the southern boundary of the studied territory.

The middle-lower paleozoic deposits are unconformably overlain by the rocks of the Pahlawahn suite characterized faunistically. Its lower contact is not observed within thelimits of the studied territory.

The middle-lower paleozoic deposits are represented by a very thick strata, grey-green, grey, brown-grey, composed of monotonous interbedding of slightly metamorphosed quartz porphyrites, dacitic porphyrites, effusions of basic composition, acid tuffs and basis effusions, tufogenic sandstones and phyllites. The thickness of some beds varies within the limits of 1-20 m. Interbeds of grey marmorized limestones / 0.2-50.0 m. are observed among this strata and particularly at its top. Usually these marmorized limestones do not contain organic remains and only sometimes, as it was seen in the upper reaches of the Rod-i-Maluma stream, recrystallized columnals are observed in them.

The band of the middle-lower paleozoic deposits traced at the southern boundary of the studied territory, is composed essentially of changed effusions of basic composition. In all probability, the lowerest horizons of the strata crop out here.

A description of rocks which are mostly spread among the middle-lower paleozoic deposits is given below.

Quartz porphyrites are grey-green, brown-grey rocks of porphyric texture. Quartz and plagioclase impregnations are 10-15%. Their sizes vary within the limits of 0.2-0.9 mm. The microfelcitic basis mass is composed of an aggerate of small grains / d- 0.2 mm/ of quartz, feldspars and the ore mineral. The rocks are slightly metamorphosed. The secondary nematoblastic texture is developed in them locally. Neogeneses of muscovite and chlorite are nest-like arranged. The size of their flakes reaches 0.3 mm. Sometimes the banded arrangement of chlorite and carbonate, underlying the primary fluidalness of the rock is seen.

Dacitic porphyrites are grey-green massive rocks of porphyric structure. The impregnations are represented by rare grains of quartz and almost entirely decomposed plagioclase. The microlitic basis mass is made up of small laths of plagioclase and grains of epidote, developed out of the dark mineral. Carbonization is seen in the rocks. Single amygdules are filled with chlorite and chalcedony.

Effusions of the basic composition are grey-green, massive rocks of porphyric texture. The impregnations make 10-15%. They are represented by amphibole. The microgranular basic mass is entirely composed of the epidotized dark mineral and feldspar, in equal rations. The ore mineral is present.

Tuffs of acid and basic effusions are grey, grey-green, brown-grey schistose

massive bedded rocks, of psammitic lithocrystalloclastic texture. The fragment size does not exceed I.0 mm. In the acid tuffs they are composed of plagioclase , quartz, porphyries, felsite; in the basic ones - by plagioclase, dark minerals, basic effusions. The cement is basaltic, ashy. At present it is recrystallized. Sphene is present. Chloritization, carbonitization, sericitization, epidotization are developed.

Tufogenic sandstones are gray, gray-green, brown-grey non-clearly-bedded rocks, of psammatic texture, The fragments are of middle roundness, measuring up to I.0 mm. They are made up of quartz, effusions and the ore mineral. The cement is porous. Chloritization processes are developed.

Phyllites are gray-green, gray schistose rocks of microblastic lepidograno texture. They are composed of micaceous flakes, quartz grains, grains of feldspar and the ore mineral.

The former investigators / Menesie, I964/ observed gneisses, amphibolites and crystalline schists alongside with phyllites in their composition. As it was mentioned Middle-lower Paleozoic is composed of poorly metamorphosed rocks, not reached the facies of green schists. The deeply metamophosed rocks / migmatites, amphibolites, crystalline schists/ appear near the massif of intrusive rocks and are the product of contact metamorphism / see the section " Intrusive rocks" /.

The maximum apparent thickness of the Middle-Lower Paleozoic is 2000-2500. As it was mentioned above there was no determining organic remains among the described deposits. Their middle-lower paleozoic age is determined by the deposits of the Palawan suite overlying with non-conformity and containing a fauna of Tournai, Visean, Namurian stages. Lower Paleozoic among the deposits described is supposed by us on condition only on the basis of their great thickness.

The middle-lower paleozoic deposits accumulated under the conditions of intensive warping of the sea basin bottom. The periods of volcanic flows and accumulations of pyroclastic material for the middle-lower paleozoic time were repeatedly changed by the periods of the deposits of terrigenous and carbonaceous rocks.

CARBONIFEROUS SYSTEM / C /

The TCarbiniferous deposits are divided into two suites: Palawan of the Lower Carboniferous age and Sangizard of the Middle Carboniferous age.

Comparison of stratigraphical sections of these suites for the investigated region is shown on figure 7.

Palawan suite / Lower Carboniferous/ / C_I pl/

The deposits of the Palawan suite are distributed in the south-east of the studied territory at an area of 50-60 km. They crop out as a wide band along the northern versant of the Selsela Koh-i-Dawandar. Their small outcrop is observed also on the southern versant, north of the settlement Chashma Abi-Garm.

The Palawan suite overlies the Middle Paleozoic with erosion and angular unconformity in the upper reaches of the short right tributary of the stream Rod-i-Maluma, 6-8 km south-east of the settlement Dalantu. The basal level of quartzy conglomerates, gritstones, turning into coarse-grained sandstones along the strike, is seen in its basement here. Its thickness does not exceed 30 m. The pebbles are well round, up to 5 cm in diametre. Such a sharp contact was not observed in other places. Non-evident stratigraphic disconformity takes place. The Palawan suite is conformably overlain by the Sangizard suite, locally with small erosion.

The described deposits are represented by the strata, composed of interbedding argillites, aleurolites, sandstones, limestones. The thickness of some interbeds varies within the limits of 0.2 - 40.0 m. Levels of fine-pebbled conglomerates and gritstones pinching out along the strike, are often observed. Sandstones and aleurolites prevail in the lowermost strata of the Palawan suite; limestone interbeds are seen more often. Levels of effusive and volcanic-sedimentary rocks , I - I5 m thick, are observed everywhere. They are composed of quartz porphyries, basalt porphyrites and their tuffs. Small interbeds and nests of hematite are observed among the effusions. The dikes of the same rocks, which are connected with them spatially and genetically, are seen in immediate proximity. The argillites are widespread at the top of the suite, thin /3 - 20 cm/ coal sheds are often observed. Coal seams, lense-like in form, are observed in the environs of the Pahlawahn settlement. The thickness of the coal seams is I - 2 m / see the section "Minerals"/.

Argillites are grey green, grey, dark grey, often aleuritic or carbonaceous. Locally they contain thin interbeds / 3-20 cm of coal/.

Aleurolites are grey-green, grey, often argillaceous. Sometimes carbonaceous materials are observed in them.

Sandstones are grey-green , grey, polymictic, medium - and fine-grained with carbonaceous or argillaceous-carbonaceous cement.

Limestones are grey, dark-grey detrito-organogenic or aphanitic.

Quartz porphyries are grey-green, grey with quartz impregnations and of almost entirely decomposed plagioclase up to I2%. The micrograined basic mass is of fluidal and agglomeratic structure . It is composed of grains of quartz and feldspar. There is crustalline volcanic glass. Chloritization, sericitization are observed.

Basalt porphyrites are grey-green, grey, of porphyritic texture. The imprgnatio /measuring up to 3 cm/ are entirely replaced by uralite, epidote, calcite; The basic mass is hyalopilitic, microlitic or of microintersertal texture. It i made up of chloritized volcanic glass with grains of plagioclase and the dark

mineral. The structure is massive or amygdaloidal. The amygdules / I mm / are filled with calcite and chlorite.

The tuffs of quartzy porphyrites and basalt porphyrites are grey-green, grey, of psephite-psammite vitrocrystalline-clastic texture. The first are composed of fragments of glass, porphyries and minerals; the second - of glass, porphyrites and minerals. The cement is ashy-carbonaceous.

The tuffs of basalt porphyrites are grey-green, grey, with psephite-psammite vitrocrystalline-clastic texture, made up of fragments of glass, porphyrites and minerals. Cement is ashy-carbonaceous.

Among the described deposits in the lower and middle parts of the section the remains of corals and crinoids were found; among which are distinguished: Cyathoclisia cf. modavenese / Salee/, Siphonophyllum sp. ex gr. S. cylindrica Scouler, Cyathoclisia sp., Laccophyllum sp., Pentagonocyclicus cf. circumvalatus minor Yeltyschewa, Cyclocyclicus cf. suni Dubat. et Shao, C. cf. dignus Yeltyschewa /in litt./. Anthinocrinus sp. By the conclusion of T.A.Dobroljubova, the corals determine the age of the including layer as Upper Tournai. The crinoids, by the Shewchenko definition, are more typical for the Tournai than the Visean stage.

In the upper reaches of the Rud-i-Maluma r. in the deposits of the Pahlawahn suite at more lower stratigraphical level were, besides, found single corals of poor igtact; according to Dobrolubova T.A. they are of Devonian age. However one cannot be sure of the fauna presense in situ. In higher parts of the section of the Pahlawahn suite in the surroundings of of the Pahlawahn and Sang-i-Zard villages numerous corals, crinoids and brachiopods are found.; among which T.A.Dobroljubova , V.L.Lelishus, N.V.Litvinovich and T.V. Shevchenko determined: Lithostrotion caespitosum /Martin/, L. cf. macceyanum Edw. et Haime, Cinodendron columeh Benson et Smith, Palaeosmilia sp., Gangamophyllum sp., ? Sychnoelasma sp., Syringopora ex gr. reticulata Goldf., Gigantoproductus aff sp., Chonetes sp., Brachythyris sp., Ortholetes sp., the above fauna is typical for the Visean stage. Stratifera sp., Gigantoproductus aff. superbus Sar., Spirifer bisulcatus Sow., - this fauna is usually found in the upper part of the Lower Carboniferous period, and more often in the Namurian stage. In Kazakhstan and Central Asia these forms are described of the deposits of the Namurian stage. Pentagonocyclicus cf. falsus Dubat. et Shao, Cyclocyclicus ex/ gr. arenarius Yeltyschewa et Schewschenko, C. rugosus Yeltyschewa et Schewtschenko - are spread from Visean- Namurian /?/ to the middle section of the Carbonaseous system.

Cyclocyclicus arenarius var. cingulata Yeltyschewa et Schewtschenko are found in the Upper Visean, Namurian and Middle Carboniferous. Thus the above determinations of the organic remains say for Lower Carboniferous age of the deposits, enclosing them.

For the first time the lower carboniferous deposits on the Selcela Kokh-i-

Davindar ridge were observed by K.Grisbakh in 1886 / Menesie, 1964/, who found productids, bryozonas and crinoids of the Lower Carboniferous age in the interbed of black limestones. He considered these deposits as equivalent to the beds of Rabat-i-Pai, the sequance of which was described by him near Herat.

The accumalation of the deposits of the Pahlawahn suite, probably, took place in regressive-marine submontane depression, which was situated in the periphery of mountain structures. It took place in near-shore-marine conditions. The composition of the rocks of these strata: limestones, argillites , aleurolites, sandstones, conglomerates, coals is indicative of it. They are the facies of the shallow sea, from which laggons adjourned periodically. The coal accumulation was confined, probably, to small deltas. It was often broken by sea ingressions, the essentially vitrainous composition of the coals / V=87-95%/ the lense-like form of coal seams and their inconsiderable thickness, 3-20 cm, are indicative of it. Somewhat long periods of coal accumulation, which brought to the formation of coal seams of workable or near to it thickness, were in the end of the age an inconsiderable volcanic activity took place, of which are indicative the volcanic formations among the described deposits.

Sangi Zard suite/ Middle Carboniferous/ / C_2 sn/

The deposits of the Sangi Zard suite are spread, mainly, in the southeast of the studied territory. They occupy about 40 sq. km. They are traced along the narrow band of the northern versant of the Selcela Koh-i-Davindar ridge. Besided, these rocks crop out in small tectonic blocks and in the cores of anticlinal texture on the southern versant of the Selcela Koh-i-Band-i-Baba.

The deposits of the Sangi Zard suite concordantly overlie the Pahlawahn suite, locally with light erosion. The erosion was fixed in the middle reaches of stream Red-i-Maluma, 3 km east of the settlement Pahlawahn, as well as in the upper reaches of its large left tributary, 7-8 km southeast of the same settlement / Fig.7. sec. 4, sec.5/. In this case the basal level of conglomerates , gritstones and coarse-grained sandstones is observed in its base. The pebble is well rounded, up to 6 cm in diametre. It is composed of quartz, schists, effusions, sandstones, limestones. The cement is basal, carbonaceous. The thickness of the basal bed is 3 - 20 m. The Sang-i-Zard suite is unconformably overlain by red deposits of the Permian age and deep erosion.

The Sangi Zard suite is represented by thick strata, which is made up of interbedding of thin-bedded and thick-bedded limestones. The limestones are aphanitic or detrite-organogenic. Reef-genic limestones, without bedding, are observed southeast of the settlement Sangi Zard. Interbeds of limy sandstones and black argillites are developed in the area of the Pahlawahna coal manifestation. Grey-green quartzite-like sandstones, interbedding with limestones and limy argillites appear among the described strata at the southern boundary of the studied territory, 7 - 8 km southeast of the settlement Pahlawahna. At the southern versant of the Selcela Koh-i-Band-i-Baba ridge the Sangi Zard suite id represented by interbedding of dark grey coaly argillites, aleurolites, sandstones and limestones. Probably, it undergoes facial changes to the north. Maximum apparent thickness of the Sangi Zard suite makes 400 - 500 m.

In the middle part of the section of the Sangi Zard suite the remains of numerous crinoids were gathered out of limestones: Cyclocyclicus rugosus Yeltyschewa et Schewtchenko, C, ex gr. arenarius Yeltyschewa et Schewtschenko, Pentagonocyclicus circumvalatus Yeltyschewa et Schewtschenko var. afganica, var. nov., Platycrinus sp., Cromyocrinus sp., Dicromyocrinus sp., Synyphocrinus sp., which are, by the conclusion of T.V. Schewtschenko, are typical for the middle section of the Carboniferous system.

In the same limestones Choristidae were found, which are of Middle Carboniferous in appearance, by the conclusion of M.V. Litvinovitch.

In the upper parts of the section the corals Campophyllum nikitini Stuckenberg, Bothmophyllum sp., having Middle- Upper-Carbonaceous age by the definition of T.A. Dobroljubova, were taken.

These gatherings of the remains of the fauna prove the Middle-Carboniferous age of the Sangizard suite. One find of corals should be noted / 2 km south of the Sang-i-Zard village/ among which T.A. Dobroljubova determined the following Upper Visean forms: Diphyphyllum gracile Mc Coy, D. cf. gracile Mc. Coy, D. aff. simplex / Thompon/.

It is not excluded that the fauna id redeposited, as the upper levels of the Pahlawah suite, on which the Sangizard suite lies with erosion, contain, in the main, the Namurian fauna. The formation of the deposits of the Sangi-Zard suite took place in th conditions of a warm shallow sea. Numerous remains of crinoids and corals are indicative of it. At the beginning of the accumulation epoch of these strata the stable conditions of the marine basin regime set, and the latters were preceeded by some transgression. The basal conglomerates in the base of the Sang-i-Zard suite are indicative of it. In this shallow sea reefs formed at some areas/ southeast of the Sang-i-Zard village/.

The conditions of sedimentation were the same as in the period of the Pahlawahna suite accumulation on the southern versant. The deposits of the Sang-i-Zard suite are represented by near-shore-sea facies/limestones, conglomerates, sandstones, argillites and

PERMIAN SISTEM. /P/.

On the studied territory the Permian deposits crop out at an area of about 850 km^2 They can be traced from the region of the settlement Palawana in the middle reaches of the Rod-i-Maluma, eastwards-in the upper reaches of the Kushast along the northern versant, situated between the Rod-i-Karukh and its left tributarry-the Rod-i-Maluma. Another band of Permian deposits extends from the western frame of the investigated area along the southern versants of the Selsela Koh-i-Band-i-Baba in the upper reaches of the Rod-i-Karukh. Here they crop out in the mountains of Koh-i-Dawindar and on the horth- western versants of the Koh-i-Dawindar. From here the Permian deposits are traced further eastwards. They were observed on the south-eastern versants of the Selsela-i-Dawindar, in the basin of the Darra-i-Magozar /the right tributary of the Harirod add east of the region.

Small outcrops of the Permian rocks are on the northern versants of the Selsela Koh-i-Band-i-Baba in the upper reaches of the Darrya-i-Hoja-Shahab, the left tributary of the Kushk.

The Permian deposits overlie Carboniferous and Middle Paleozoic deposits transgressively with deep erosion and discordance. The are overlain bytufogenic-sedimentary formations without apparent angular discordance. In other case the deposits of the Lower Triassic or of the Albian stage overlie immediately the Permian rocks transgressively and discordantly.

The Permian deposits are intensively dislocated. At considerable spaces they have a monoclinal dip of seams at angles from 30 to 50^0, either -northwards -in the ridge between the Rod-i-Karukh and its left tributary -the Rod-i-Maluma, or southwards, for example, in the left side of the Rod-i-Karukh in its upper reaches. In other sections of the region on the southern versants of the Selsela Koh-i-Band-i-Baba, in the ridge Koh-i-Band-i-Zarmast, and also in the basin of the Darra-i-Magozar, they are dislocated more complicatedly: crumpled into steep folds with dip angles of seams on the wings from 30 to 70^0, and broken by erosions. In fractured zones bedding at angles $70-85^0$ is sometimes observed.

At the whole area of distribution the Permian system is represented by red deposits, among which argillites, aleurites, sandstones, conglomerates prevail. Interbeds of limestones and marls are seen seldom among these rocks.

The following rocks are most widely distributed among the Permian deposits:

Argillites, dark-red, red-broun sometimes-bluish green, compact, aleuritic, bedded or cloddy.

Aleurites, red-brown, violet-red, cherry-red, thin-, medium-bedded or

cloddy, slightly-calcareous.

Sandstones, reddish-brown, violet-gray, lilac-gray, more seldom-greenish-gray, fine-to coarse-grained, polymictic, more-seldom-quartxy with clays or calcareous cement.

Conglomerates, red-brown more seldom- greenish-gray, fine-medium pebbly to medium-pebbly to medium-bouldered. The coarse-gravel-is angular, more seldom-reundéd, up to 20cm in diemetre. It consists of metamorphic and siliceous schists, blacko or greenish-gray limestones, sandstones and quartz. The cement is sandy-calcareous, basal or porous. /interstitial/.

Limestones , ofter gray, sometimes- brownish-gray, violet-gray, medium-thin-bedded, compact, sometimes- with shelly break; sometimes thin interbeds of flints are included.

Marls, green, compact, thin-bedded. Three strata can be distinguished in the sequence of the Permian deposits by colour and their lithological composition.

The red-brown strata is the oldest and composed of aleurites, argillites, sandstones In its base basal conglomerates lie.

The lilac-gray strata overlies conformably the red-brown ones and are characterized by violet-gray and lilacegray colour of the rocks, among which sandstones with subordinate interbeds of gritstones and conglomerates, interbedding with argillites and aleurites in the middle part of the sequence.

The dark- red strata crown the sequence of the Permian deposits. Cherry-red anddarl red argillites and aleurites with subordinate interbeds of sandstones are typical of it.

Due to the absence of clear boundaries in colours, facial changeability to distingui the above numerated strata on the geological map. A more detailed description of the strata is given below; their comparison for the investigated region is shown on fig. 8.

The red-brown strate crop out mainly in the south-western part of the region- in the lower and middle reaches of the Rod-i-Maluma /fig. 8,/ and on the northern versants of the located between the Rod-i-Karukh and its left tributary the Rod-i-Maluma. The strata are of trimembral structure. Its lower part of non-persistent thickness /40-130/ is composed of fine-medium- pebby conglomerates, locally- mediumbouldered with subordinat interbeds /I-20m/ of coarse-greined sandstones.

Alternation of sandstones, gray, brownish-gray, red-brown /0.5-10m/ and aleurites red-brown, violet-red and cherry-red with a thickness of 180-200m is observed over.

Aleurites, alternating with thinner bands of sandstones /5-15m/ and more seldom-conglomerates /3-5 m/ prevail in the upper half of the sequence.

Thin interbeds of argillites, limestones and marls /0.5-2 to 10m/ are seen in separate cases just here. The apparent thickness of the deposits is 480-500 m.

The total apparent thickness of the strata is 700-800m.

The lilac-gray strata crop out in the eastern part of the investigated area in the upper reaches of the Rod-i-Karukh. Its most complete sequences can be seen the basins of the left tributaries-the Rod-i-Karukh,Shila-i-Siah,Darra-i-Paian,Sial Darra-i-Bala, Jar-i-Mohammed-Rahim,Jar-i-Ala-Savar, Jar-i-Sorh Paian and in the upp reaches of the Darra-i-Marghozor /the right tributary of the Harerod./.

The rocks of the lilac-gary strata are conformably overlain by the deposits of the dark-red strata everywhere in the basins of the mentioned rivers.There was no immediate superposition of the rocks on the deposits of the red-brown strata.

The most complete sequence of the lilac-gray strata is described in the basin the Siah-Darra-i-Bala /fig.8 /. Here in the lower part of the sequence sandstones, thick-bedded, micaceous, polymictic, more seldom-quartzy, forming bands of some ten of metres in thickness, prevail. In the sequence some bands of sandstones are divi ed by thinner bands of micaceous aleurites, mainly-quartzy gritstones and fine-pebb conglomerates. The rocks are coloured into violet-gray, lilac-gray, more seldom-red brown . The apparent thickness of the lower part of the strata is 600-650 m. In the middle part of the sequence of the strata alternation of argillites, lilac-gray, th bedded, schists, argillaceous, silky, thin-foliaceous ,aleurites-cherry-red, more s seldom-greenish-gray, micaceous, medium-bedded, sandstones, violet-gray, snuff-gra yellowish-gray, oftener--thick-bedded is observed

The thickness of the middle part of the sequence is II00-II50 m.

The upper part of the sequence is composed mainly of sandstones, reddish-gray, lilac-gray, compact, thick-bedded , quartz-like ,micaceous, polymictic. Among the sandstones alternations of conglomerates, fine-pebbly, and at the top-of aleurites, cherry-red, thin-medium-bedded , micaceous are usual. The thickness is 200 m.

The total apparent thickness of the deposits of the lilac-gray strata is I900-2000 m.

The dark-red strata are wide[illegible]spread in the ridge Koh-i-Band-i-Zarmast /fig. 8 / and in the band of the deposits, alternating in the zone of large fractures [illegible] along the southern versant of the [illegible] Selsela Koh-i-Band-i-Baba to the western boundary of the investigated region . They crop out also in the left side of the valley of the Tagab-i-Jari/ the right tributary of the Darra-i-Marghozar / in the upper part of the slope.

In the upper reaches of the Tagab-i-Mohammad[illegible]an and in the middle reaches of the Tagab-i-Jari the rocks of the dark-red strata are conformably overlain by the terrigene-tufogenic rocks of the Permian-Triassic.

The main lithological background of the strata is determined by alternating cherry-red and dark-red thin-bedded argillites and fine-grained micaceous aleurites.

Ashy-lilac and violet-gray quartz-like sandstones, greenish-gray fine-medium-grained thin-bedded aleurites and red-brown gritstones and conglomerates, forming interbeds of some tens of metres in thickness , are less spread in the strata. Lens-like interbeds of limestones are observed very seldom.Dislocation of the rocks makes the determination of their thickness difficult. Approximately it is 800-1000 m.

The summary thickness of the Permian deposits is 3400-3800 m.

In 1928 E. Trinkler wrote of the find of the Lower Permian Spirifer Wynnei Waag in red calcareous sandstones of the upper reaches of the Harirod /Petrushevski B.A., 1940/.Since that time there were no new data of the age of red rocks.

Jul P.Chepoff /1961/ and S.D.Ivanoff /1961/ distinguished the described red deposits as "amanbulak suite", stratotype of which is described in Tuarkwer /USSR/ and to which they are similar lithologically. There were no organic remains in these deposits, which had been found by the mentioned investigators.

We could not find any organic remains either, however, their Permian age is determined quite definitely by their position in the sequence between the deposits of the Middle Carboniferous and Lower Triassic, characterized faunistically.

The great thickness and persistence/continuity/ of the sequence give the ground to suppose that the Permian deposits on the studied territory are represented by both sequences.As it was mentioned, fossil remains of the Lower Permian were found in the upper reaches of the Harirod in similar red rock, and the Permian-Triassic terrigen tufogene formations conformably overlie them in the basin of the Darra-i-Marghozor. The lows of the strata can appertain to the upper Carboniferous.

Thus, the described red deposits can be confronted with faunal formations, known in Eastern Afghanistan, in age., and in paticular with the limestones of the lower part of the series Hinguil of H.H.Hyden/.1911/,which are an equivalent of fusulain limestones, described by H.H.Hyden /1911/ in the valley of Hajigor, north of Bamian.

Accumulation of red Permian rocks of the investigated region took place in coastal marine conditions. After short dewatering o f the territory The sea inrushed within its limits again at the end of the Carboniferous epoch.

The lithological composition of the Permian deposits / conglomerates, sandstone argillites/ is indicative of shallow water of the sea, perhaps, of its island character.Only in some short epochs there were conditions, favourable for the accumulatic of limestones, locally. Some Permian deposits formed in the conditions of deltas, coarse oblique bedding is indicative of the above said. Red colour of the deposits shows that there was a dry hot climate in those areas of land ,from which fragmental material was brought. The structure of these sequences was formed in the Varisci stage of tectogenesis;coarse gravel of considerably metamorphosed rocks and also of grades are in thr Permian conglomerates.

PERMIAN AND TRIASSIC SYSTEMS, NON-DIVIDED/ P-T /.

The non-divided deposits of the Permian and Triassic age are distinguished by us in the east of the investigated territory in two sections.One of them is located between the ridges Koh-i-Band-i-Zarmast and Hoja-Abdol,mainly ,on the right side of the valley of Tagab-i-Mohammad Khan, the other-further to south-east, in thr interfluve of the Tagab-i-Jari and Darra-i-Marghozor.

The area of the Permian-Triassic on both sections is not over than 12 sq.km.

The Permian-Triassic deposits overlie the terrigene red deposits of the Permian age without apparent unconformity ,and in general they are dislocated with them conformally .

In the valley of the Tagab-i-Mohammad Khan the sequence of the Permian-Triassic is of bimembral structure. Its lower part, exceeding 500 m in thickness, is composed of very uniform black, black-violet,with red hues, effusive-sedimentary and effusive rocks of the intermediate composition.

In the valley of the Tagab-i-Mohammad Khan and in the interfluve of the Tagab-i Jari and Darra-i- Marghozor the Permian-Triassic deposits are broken with granitoids and are essentially skarnized and hornfelsized on the contact with them.

Ashy tuffs,sometimes with admixture of aleuritic material, black with red -violet hue of massive structure, tuffites, black-red-violet with gray or green hue, of the intermediate composition,also of massive structure;lavas, of the trachy-andesitic composition, black with greenish hue, of massive structure, seldom-with amygdaloidal structure are seen among them.

Sometimes bands of argillites, aleurites and more seldom-fine-grained polymictic sandstones, black-lilac or lilac-gray are observed. Beds of dark,banded, argillaceous siliceous schist are seen still more seldom.

The enumerated rocks form bands of some tens of metres, isolated from each other with difficulty.

The presence of a great amount of effusive material and a sharply subordinate quantity of normally-sedimentary coarse-fragmental rocks, distinguishes this part of the sequence from the underlying Permian deposits.

The upper part of the sequence, a little more than 300 m, is composed of a varie gated series of rocks. Brownish- greenish- gray limestones /2-6 m/, bluish- or brownish-green, more seldom-lilac argillaceous-siliceous schists /2-15 m/, light brown and brownish-gray quartz-like sandstones/2-3-28 m/,light gray calcareous conglomerates /up to 10 m/ and amygdaloidal porphyrites /up to 50 m/ were observed here. In some parts of the sequence the rocks are skarnized, some beds, up to 3 m in thickness, are wholly replaced by granite skarn.

The described rocks of the upper part of the sequence are similar to the lower Triassic deposits of adjoining regions, characterized faunistically, lithologically and by the character of alternation.

In the interfluve of the Tagab-i-Jari and Darra-i-Marghosor the sequence of the Permian-Triassic is represented only by the lower volkanogenik-sedimentari part of the sequence, very similar to the above described , one, lithologically.

The described deposits do not contain fossils of organic remains and their Permian-Triassic age is ascertained conventionally on the grounds of lithological difference from the underlying Permian deposits and some features of similarity to the deposits of the Triassic age.

After the period of accumulation of normally sedimentary deposits in Permian period the appearance of volcangenic deposits shows the essential change in the tectonic regime of the investigated territory at the end of the Permian period and the beginning of the Triassic one. The accumulation of considerable masses of lava materials in this time place somewhere beyond the limits of the region, and only thin products of volcanic cruptions, scatterred by sea streams, reached the investigated territory.

MESOZOIC GROUP /M_z/.

The deposits of the Mesozoic group are widely distributed in the region, but very unevely spread on its territory.

All three systems are distinguished among the deposits of the Mesozoic group; Triassic, Jurassic and Cretaceous. The deposits of the Triassic systrm are comparatively little spread and are observed as small quences along the whole investigated area. The Jurassic sediments were seen only in one small so quence in the east of the region. The Cretaceous deposits are most widespread.

The main area, composed of Mesozoic sediments, is situated in the northern part of the investigated territory, covering partly the axial part and the northern versants of the Selsela Koh-i-Band-i-Baba and Band-i-Badgisat; Their small outcrops are fixed on the southern versants and also in the ridge Selsela-Koh-i-Dawindar.

The Triassic formations, among which thick terrigene red deposits and effusive rocks, deprived of organic remains are developed alongside with normally marine sediments with fauna, are very difficult for dismembering.

TRIASSIC SYSTEM / T /.

The deposits of the Triassic system are linedly spread in the investigated reg
Their small in area outcrops were mapped in different parts of the studied ter
ory. Their total area is a little over 100 sq.km.

The Triassic deposits overlie the Permian terrigene red deposits with erosion and angular / from 5 to 15°/ and more seldom-azimuthal /up to 25°/ unconformity, an are overlain, in their turn, either by the Middle Jurassic , or Lower Cretaceous /Al an/, or Upper Eocene /Turkestanian/ deposits with sharp erosion, angular /up to 20° and azimuthal/ up to 60°/ non-conformity.

In most places the Triassic deposits omit wholly from the sequence, being erod in the Pre-Middle Jurassic or in the Pre-Albian epoch, The Triassic deposits lie mo clinally or crumpled into folds with dip angles on the wings from 30 to 45, seldom-60°.

Naturally, under the mentioned conditions of bedding the completeness of strata in different areas is not the same. Only the lower parts of the sequence, which is of the Lower Triassic age, are preserved more often.

The Triassic deposits, as a whole, are represented by very various rocks. Ther are normally sedimentary fragmental /conglomerates, sandstones, aleurites, argillit and carbonaceous/ limestones/ as well as pyroclastic/ tuffs, tuffites and tuffitic sandstones/ deposits among them. Besides, thick lavas, mainly of the intermediate composition, are observed in the upper part of the sequence.

The character of the Triassic deposits changes greatly along the area, which makes the comparison of the sequences very difficult, taking the fact that they are poor in organic remains into consideration. However, on the whole, the types of rock their character and their correlation in the sequence, colouring and some other feat res favour distinguishing the Triassic formations uniformly among other deposits o the region.

All three sections are distinguished among the Triassic deposits. The lower and middle sections are confirmed by fossils of organic remains; the upper section does not contain fossil organic remains and is distinguished rather conventionall

According to their lithological features the Triassic deposits are dismembered into suites by us. The Jawzia suite is divided into two parts -lower and upper.

The general sketch of dismembering of the Triassic system:

1. Lower section /Verfian/.

   a/ Jawzia suite /Tijw /;

      a/ Jawzia suite, lower part /Tijw-i/;

      b/Jawzia suite, upper part //Tijw-s/;

2.Chahak suite / T_I chh/.

II. Middle section.

I/ Kamarizard suite /T_2 km/;

2/ Sanjar suite /T_2 sn/;

III. Upper /?/ section

I/ Galasum suite /T_3/?/ gl/;

2/ Tutak suite /T_3/?/ tt/.

The sketch of comparison of the sequences of the Triassic deposits of the region is given on Fig.9.

The most complete and constant sequence of the Triassic deposits, including the lower and upper /?/ sections and all the endured above suites, was observed on the southern versant of the ridge Selcela-Kohi-Dawindar south-east of the Maluma settlement. In other regions of the investigated territory only separate fragments of the Triassic sequence, mainly appertaining to its lower part, are observed.

LOWER SECTION /T_I/

The sediments of the Lower section are most widespread among the Triassic deposits. They are developed on the northern versant of the Selcela Kohi Dawindar, in the region northnorth of the settlement Kamar-i-Zard on the southern versant of the ridge Selcela Koh-i-Band-i-Baba and in the upper course of the Rod-i-Karukh in the region of the Madjed-i-Chobi coal deposit,and also on the southern versant of the ridge Selcela Koh-i-Dawindar, in the Tagab-i-Jari valley.

The deposits of the lower section are dismembered into Jawza and Chahak suits by us, as it was mentioned above.

Jawza suite /T_I jw/.

The Jawza suite is spread in all those sections, where the sediments of the Lower section of the Triassic system are developed.

Litjologically the deposits of the Jawza suite are very various and changable. In the most part of the investigated territory they are composed of carbonaceous-terrigene sediments and effusions, subordinate to them, are divided into two parts by their lithologucal features: lower /T_I jw-l/ carbonaceous - effusive-terrigene and upper /T_I jw - s/ terrigene -effusive - carbonaceous.

The Lower part of the Jawza suite /T_I jw -i/ is spread everywhere. In some areas the deposits of this age were not accumulated, probably; in other - their thickness reached 600-700 m.

By the lithological cpmposition, these deposits are not persistent and are represented by sandstones, conglomerates, aleurolites, seldom - by limestones, lavas of

of the intermediate, more seldom-acid composition and their pyroclastic derivatives- tuffs, tuff-lavas, agglomeratic lavas. Sandstones and effusive-pyroclastic rocks are most widely spread. Limestones are of subordinate importance. The terrigene rocks are usually red-brown, sometimes-with violet hue, effusive-pyroclastic- green-gray, bluish-green, gray.

A brief characteristic of the rocks, composing the lower part of the Jawzia suite is given below:

Sandstones, tufogenic, gray, greenish-gray, pale-yellow-gray, from fine- to me medium -grained, compact, consist of badly rounded or oxygonal quartz fragments plagioclase and to a less degree of lavas. The tufogenic material amounts from 20 to 25% and is represented by fragments of changed effusives with trachytic and microtrachytic structure. The cement is interstitial, argillaceous-silice ous or siliceous with rare separations of fine-grained calcite. The rock is psammitic.

Conglomerates, polymictic, gray-brown, greenish-gray, consist of medium- and v well rounded coarse gravel, small, medium and large, sometimes- with admixture of small boulders. The coarse gravel consits of quartzy porphyres, albitophyre to a lesser degree- porphyrites, granites, gray quartz-like sandstones, diabas es, red-brown aleurites, black and green-gray siliceous schists. The cement is interstitial/porous/,,argillaceous-carbonaceous, argillaceous-siliceous with sandy-gravelly filling, rather compact.

Sandstones, polymictic, sometimes-with admixture of tufogenic material/up to 5%/, red-brown, pink-red, red-violet, greenish-gray, gray (a) from fine- to coarse-grained; medium- and coarse -grained sandstones prevail. The sandtsones consist of angular and very slightly rounded fragments of quartz, plagioclase, lava, argillite, micaceous plates. The rock fragments amount to 30% in some /greywacke sandstones/ cases. They are psammitic. They contain lenses of small gravel, rare small coarse gravel of upper Paleozoic rocks. The cement is porous, siliceous-argill aceous, more seldom-argillaceous-carbonaceous. The sandstones are horizontally bedded, platy, vague oblique bedding, wave-surfed traces are seen.

Tuffites, gray, greenish-gray, gray-brown, consist of sharply oxygonal, some times- of curved thin fragments of quartz, plagioclase, altered lava, altered v volcanic glass. The size of the fragments is from 0.1 to 0.6 mm, more seldom- up to 2 mm. Quartz prevails/40-60%/. The cement is interstitial, quartzy-seric citic, sometimes-carbonaceous / calcite/.

Aleurites, polymictic, sometimes-with admixture of tufogenic material /up to 8%/, micaceous, brown-red, more often-green-gray and gray, compact, often-platy, with siliceous-argillaceous, often-carbonaceous porous cement. The aleurites

mainly consist of oxygonal or slightly rounded fragments of quartz, to a lesser degree of plagioclase, rare plates of altered mica. Thin lamination, wave-surfed traces, casts of small pelecypods.

Argillites, gray, greenish-gray, more seldom-gray-brown, compact, cloddy, sometimes-s euritic or calcareous, often- schistose, more seldom-cloddy.

Limestones, gray, yellow-gray, yellow, calcitized, compact, sometimes-fine-oolitic, in some interbeds- holocoquina, from small thin-walled non-extracted pelecypods.

Albitophyres, greenish-gray, violet-gray, sometimes-spotty, amygdaloidal, not very compact. Albite /up to 20%/ and augite / up to 5%/ are seen in porphyric separations. In the main mass-albite laths, seldom- potassium feld spar , the interstices are fill ed with altered glass, calcite, sometimes-chlorite. Amygdules from 1-2 to 7-8 mm ,rou ded in form , are filled with calcite, chlorite or chalcedon. The rock is amygdaloi al, porphyric. The main mass is trachytic, turning into orthophyric.

Orthophyres, greenish- or pinkish-gray, sometimes- with violet hue, compact. The rock contains rare porphyric separations, replaced with calcite. The main mass consists o microlites, potassium/alkaline/ feld spar with a small amount of oligoclase laths, isometric-square i n form and single separations of quartz. The rock is relict-porphyic, the main mass is orthophyric.

Plagioporphyres- gray, greenish-gray, sometimes- with pinkish hue. The rocks are massive or coarse- fine-bedded .Oligoclase /up to 25%/ ,more seldom-biotite / up to 10%/ are in porphyric separations. Oligoclase, potassium feld spar, quartz / up to 5%/ , carbonate prevail in the main mass. The rock is porphyric, the main mass is felsiti turning into granulitic.

Quartz porphyres - light gray, sometimes- pinkish, massive, similar to the [illegible], above described, by their composition.

Agglomeratic lavas and tuff lavas, of the albitophyric, plagioporphyric composition- green-gray, unevenly coloured, similar to the ones, above described by their composi on. / page /.

Tuffs of quartzy porphyre , ashy or psammitic, more seldom- psephitic, usually-gray bluish, gray, pinkish, greenish, consist of fragments of felsitic quartzy porphyre, quartz, alkaline feld spar, plagioclase. Sometimes slightly rounded material / up to 5%/ -quartz, felsite, sandy or aleuritic tuffs are contained in a small quantity. Th rock is psephitic-psammitic-aleuritic, crystallolithoclastic.

The description of some sequences of the lower part of the Jawzih suite is give below:

In the Rod-i-Maluma basin the lower part of the Jawzih suite is represented mai ly by conglomerates,, over which red sandstones, gray aleurites and argillaceous-

siliceous schists with tuff interbeds are seen.

The sequence near the settlement Jawzak /fig.9 / has the following structure/upwards/:

I.Conglomerates, brown-gray to red, rubbly-pebbly	from 2 to 20
2.Sandstones, polymictic, red-brown with violet hue, coarse-grained, with gritstone interbeds with small coarse gravel, obliquely laminated	from 20 to35
3.Interbedding of sandstones and aleurites, greenish-gray, violet-gray, thin-laminated	25 m
3km south-west the thickness of this bed increases up to 104 m.	
4.Schists,gray, argillaceous-siliceous, compact, platy, or small-fragmental, with interbeds of light bluish-green tuff, of the acidic composition, slightly calcareous /up to 0.8 mm/	20-25 m
The total thickness	from 67 to

On the northern versant of the Selsela Koh-i-Band-i-Baba , in the Darra-i- Chaq basin / fig.9/ green-gray conglomerates, composed mainly of coarse gravel of the effusive rocks, over- interbedding of gray and cherry-red medium-grained lithoclastic tuffs, violet-gray tuff conglomerates with well rounded coarse gravel of green and re siliceous rocks, quartz-like sandstones and granites, with tuff cement were observed the lower part of the Jawzak suite.

The tbtal apparent thickness is about 30.0 m.

Somewhat east of the Darra-i-Chartaq valley the described deposits, probably, ar replaced by effusive formations. They are mainly violet-gray amygdaloidal albitophyre Beds and lenses of lava breccia are seen among them. In other places of the same outc gray, brownish-gray, compact plagioporphyres without amygdaloidal separations prevai Apparently,reddish-brown to ashy-gray tuff lavas and lava breccias of the same composition, containing fragments of effusive and red rocks with beds of cherry-gray fine- medium-grained sandstones with interbeds of quartzy gritstones occu in the lower of the sequence.

The described rocks are broken by dikes of dark green-brown lamprophyres,from th first to 10-12 m in thickness.

The total apparent thickness of the described effusive formations is not les t 150.0 m.

East /10-12 km/ of it,on the same southern versant of the ridge Selsela Koh-i-Ban Baba in the basin of the Darra-i-Benosh /fig.9/.the lower part of the Jawzak suite i

has a coarse-terrigene composition again and is represented mainly by conglomerates and sandstones ,aleurites and rare beds of limestones, as in the region of the Rod-i-Maluma r.,The total thickness is up to 145 m.

At last, in the east of the investigated territory ,in the upper course of the Rod-i-Karukh and in its left and right tributaries, the lower part of the Jawish suite preserves mainly coarse-terrigene character and is represented by red rocks:conglomerate es, sandstones, aleurites and argillites with subordinate beds of tufogenic sandstones and tuffs and rare tuff lavas and lava breccias.The thickness of these deposits increase es up to 704 m in comparison with the above described ones.

The sequence in the region of the coal manifestation / fig. 9/ of Madjedi-Chob-i- has the following structure / upwards/:

I. Interbedding of conglomerates, tuffites, tufogenic sandstones, aleurites and argillites, red brownish in colour.Some rare beds of sandstone have light , nearly white colour.

Medium- to coarse-pebbly conglomerates compose beds from 1-2 to 16 m. The coarse gravel is medium- and coarse-rounded.

Sandstones are mainly medium- and coarse-grained, sometimes- with admixture of gravelly and pebbly ,material, as lenses and separate inclusions in the sequence prevail over other rocks.

Argillites are usually foliaceous, aleuritic, and sandy argillites are of subordinate meaning.

The thickness of the described deposits sharply changes from the first tens to some hundreds of metres. South of the coal deposit of Madjed-i-Chob-i- it reaches its maximum value -380 m.

2. Sandstones, polymictic, often-tufogenic, white, gray, greenish-gray ,greenish-brown, violet, medium- and fine-grained in the upper part with subordinate interbeds of greenish-blue tuffs of the acid composition, compact, platy, ringing- 124 m.

In the north-western section of the Madjed-i-Chob-i, coal deposit, probably, in the base of this band tuff-lavas, lava breccias and conglomerates of medium- and coarse gravel and rare boulders of effusive rocks, cemented with lava of the intermediate composition lie.

3. Aleurites,gray and gray-green, fragmental with interbeds of compact, gray-brown fine-grained sandstones-about 100 m.

4. Sandstones, gray, pinkish, with interbeds of tufogenic brownish-red , compact sandstones -100 m.

The total thickness -674-704 m.

As one can see from the given descriptions the lithological composition and the thick ness of the lower part of the Jawzin suite within the limits of the investigated region change essentially. Probably, it corresponded to the specific conditions of accumulation of these deposits in dismembered erosive-tectonic depressions, appeared here at the end of th Permian and in the beginning of the Triassic periods. The material, brought to these depres sions, formed mainly due to Permian red deposits, that is why the deposits of the lower part of the Jawzin suite are similar to the rocks of the Permian and also of Permian-Trias sic age in colour and can be distinguished from the latters with great difficulty.

The deposits of the lower part of the Jawzin suite resemble shallow coastal formation , formed mainly due to intensive supply of coarse terrigene material with temporary stre streams from the land, located in proximity, of desert of half-desert landscape with a hot arid climate,

Disappearance of red colour and appearance of more thin-grained laminated rocks with wave-surfed traces and fine- pelecypod fauna in the upper part of the sequence point to deposition of coarse-terrigene material in shallow movable environment in the condition of its reduced supply , probably, in connection with its general lowering and the removal of the coastal line.

Volcanic activity located in separate sections at this time and was not connected/ / or was not been connected always/ with erosive-tectonic depressions spatially, where coarse terrigene sediments accumulated.

No definable organic remains were found in the described deposits. Their lower Trias ic age is determined by their position in the sequence: they overlie the deposits of the Permian age discordantly and are overlain by the limestones of the upper part of the Jawzin suite concordantly, which contain fossil fauna, typical of campyl beds of western Europe.

The Upper part of the Jawzin suite / Tju-s / is developed more in comparison with the lower one. The deposits of this age overlie the lower Jawzin carbonaceous-effusive-t rigene deposits conformably, and in some places / the right bank of the Rod-i-Maluma/, the upper course of the Daraht-i-Tut valley, the left bank of the Tagab-i-Jari valley and in other places they overlie immediately red terrigene rocks of the Permian age with angu ar unconformity.

In the western part of the investigated region the sequence of the upper part of the Jawzin suite is very uniform. The prevailing rocks here are limestones, massive or lamin ed, sometimes-pseudoolitic, more seldom-sandy, calcareous sandstones and argillites. In the eastern part of the region, sandstones, aleurites, lavas of the intermediate composit on and pyroclastic formations are widely developed , besides limestones. On the southern slope of the ridge Selsela Koh-i-Dawindar in the Tagab-i-Jari valley the suite sequence becomes essentially effusive with subordinate sedimentary rocks.

A brief characteristic of the rocks, composing the upper part of the Jawzin suite is given below.

Limestones, white, gray, gray with violet hue, yellowish, pinkish, fine-grained, sometimes-aphanitic, compact, seldom-oolitic or pseudoolitic with fine organic detrite. The pseudooolites often amount to 60%, their size is from 0.I to 0.8mm; organic detrite, measuring from 0.8mm is distributed very unequally. Sometimes, admixture of aleuritic or sandy material / up to 5-8%/, consisting of grains of quartz and feld spar, more seldom -of changed felsite. The limestones are massive, non-clearly bedded, more seldom-thin-bedded up to platy. They are from medium- to fine-grained, more seldom-aphanitic.

Sandstones, feldspathic-quartzy, gray, with yellow or pinkish hue, more seldom-pink, fine- medium-grained, of badly and medium-rounded grains, calcareous, compact. Sometimes they contain admixture of tufogenic material / up to 60%/. They are psammitic.

Argillites, light gray, slightly sandy or aleuritic, calcareous, foliaceous or cloddy. They are pelitic with transition into aleuro-pelitic.

Aleurolites, polymictic, gray, greenish-gray, often-micaceous. Quartz prevails. Th The cement is porous, basal, siliceous. They are compact, cloddy, or platy, sometimes-thin lamination is observed.

Sandstones, tufogenic, polymictic from medium- to coarse-grained, gray, greenish-gray, pinkish-gray. The tufogenic material is from I0-I5 to 20-25%, slightly rounded or angular. The cement is porous, argillaceous-siliceous, slightly carbonaceous. The rock is psammitic.

Aleurolites, tufogenic OF THE SAME composition, as the above described sandstones, only with smaller dimensions of the grains. Thin horizontal lamination is often seen in the aleurolites. They are aleuritic.

Tuffites, gray, greenish-gray, pinkish-gray to brown, from fine- to medium and more seldom-coarse-grained feld spars, plates of mica and tufogenic material AND quartz grains, medium- and slightly rounded in a quantity of 30-70%. The tufogenic material is rounded worse and consists of fragments of lava of the albitophyric composition. The cement is porous, argillaceous-siliceous, sometimes- with quartz separations. They are psammitic , lithoclastic.

Tuffs, of trachyandesite /of plagioporphyre/-gray, greenish-gray with violet hue to brown, compact rocks, consisting of fragments /0.5-5 mm/ of trachyandesite, sometimes-albitopyres, of cemented, crystalline glass, saturated with ashy material in a different degree. They are vitrolitoclastic, psammitic.

Tuff-lava of albitophyre, more seldom -of plagioclase porphyre and quartzy porphyre are greenish-gray, reddish, violet-gray, The main lava mass is saturated with fragmental material to a differenet degree. The fragmental material consists of fragments of albitophyres, more seldom- of plagioclase porphyre, measuring from parts of mm to 5-I0mm. The rock is psammitic, lithoclastic.

Agglomeratic lavas, green-gray, pink- gray with violet hue, unequally coloured. Fragments of albitophyre, more seldom- of plagioclase porphyre, measuring up to I0 cm in diametre, more seldom- up to 0.5m are soldered with psephitic lithoclastic tuff, locally with lava, sometimes with amygdaloidal one. They are agglomeratic, psephitic, lithoclastic.

Andesitic porphyres- gray-green, black-green, green-brown, unequally coloured, often-amygdaloidal rocks. Highly altered intermediate plagioclase /No.35-45/ is in porphyric separations;laths of andesine, the interstices between which are filled with crystalline glass, calcite, sometimes- with chlorite, are in the main mass. The amygdaloidal separations are distributed unequally. They are rounded in form,measuring from 1-2 to 5-8 mm and are filled with calcite, chlorite and chalcedon. The rock is amygdaloidal, porphyric;The main mass is intersertal with transition to trachytic.

Albitophyres , green-gray, usually unequally coloured, massive. Albite and seldom-augite - in small porphyric separations. Small amygdules, rounded in form, filled with calcite, are in some sections. They are porphyric amygdaloidal, the main mass is trachytic or microtrachytic.

Plagioclase porphyres,resemble albitophyres in their outward appearance, differ from them in content in impregnations and in the main mass of plagioclase No. 35-40 and and somewhat larger content of dark minerals / augite/. They are porphyric, the main mass is ortophyric with transition into trachytic.

Quartzy porphyres, light, usually pink, sometimes-gray with rare impregnations of quartz / 0.5-1.5mm/. Plagioclase,potassium feld spar, quartz;rare separations of calcite,probably, out of plagioclase. They are porphyric, the main mass is felsitic.

The description of some sequences of the upper part of the Jawza suite is given below:

In the west of the investigated region ,in the Rod-i-Maluma/ fig.9/ the upper part of the Jawza suite is composed of limestones, gray,yellowish,,massive or platy, with lenses of sandy limestone. Beds and lenses of gray aleuritic argillite, transforming into aleurite, more seldom- beds and lenses /1-2m/ of light red-brown calcareous sandstone are contained in the upper part. In the upper part of the sequence the limestones are often fine pseudooolitic. The fossils are gathered from the lower and middle part of the sequence. They show the age of the described rocks.

The thickness is 220.0 m.

On the southern slope of the ridge Selsela Koh-i-Band-i-Baba, in the watershed of the rivers Rod-i-Darakht-i-Tut and Darra-i-Chartaq in the upper part of the Darra-i-Chartaq, and also east of it, in the middle part of the Darra-i-Benosh valley / fig. 9/ the upper part of the Jawza suite is represented also by limestones, gray, brownish-gray sometimes-light-cream-colored,yellowish, more seldom-green-gray,or pinkish, platy -in the bottom, more massive -in the top.Fine pseudooolitic differences are often seen among them. Rare fauna, badly preserved, is contained in the lower part of the limestones.

The apparent thickness of the limestones reaches the largest value in the Darra-i-Benosh valley and amounts to 864.0 m.

In contrast to the limestones of the Rod-i-Maluma region the described limestones are characterized by relative [illegible] purity: they do not contain lenses and partings of terrigene formations almost.

In the east of the studied territory in the upper course of the Rod-i-Karukh the sequance of the upper part of the Jawza suite changes essentially in the region of the Madjed-i-Chob-i- coal deposit. Alongside with the limestones considerable strata of terrigene and effusive rocks appear.

Thus, for example, south of the Madjed-i-Chob-i coal deposit / fig.9/the following minerals overlie the lower terrigene part of the suite without visual unconformity:

1. Limestones, gray, platy, compact with fauna remains: Naticella /Nathiria/ ex gr. costata Mstr., Myophoria cf. laevigata /Ziet./. Eumorphotis sp., ?Kashmirites sp. from 10 to 50 m
2. Sandstones, red-brown with partings of aleurolites and conglomerates, fine-pebbly from 0 to 20 m
3. Andesitic porphyres, green-gray to black-greenm spotty, at the top they contain beds, enriched with pyroclastic material/ tuff- lava, more seldom- lava-breccia of the same composition/ from 50 to 75 m.
4. Limestones, gray, sometimes- yellowish, aphanitic, organogenic-detritic- in some partings from 20 to 30 m.
5. Interbedding of sandstones and aleurites, pink and red, trasforming into calcareous differences along the strike and then in gray-pink sandy limestones with partings of tuffs, green-bluish, and gray-violet argillites. The beds are of 0.5-2-3 m in thickness. Sandstones prevail about 300 m.
6. Limestones, gray, yellow-gray, aphanitic, dendritic -in some partings, fine-pseudooolitic, sometimes- sandy, platy. Locally there are partings of calcareous polymictic sandstones. The limestones contain Naticella/Nathiria/ ex gr. costata Mstr./. The thickness of the limestones changes from 100 to 170m.

The total thickness is from 480 to 645 m.

The sequence of the upper part of the Jawza suite becomes essentially effusive in the south-eastern part of the investigated territory, in the Tagab-i-Jari valley, as it was mentioned already. The deposits consist of albitophyres, to a lesser degree- of plagioclase porphyres, seldom-agglomeratic lavas and tuff-lavas of the same or the mixed composition. Tuffs, tufogenic sandstones and aleurolites are in less quantity and limestones are lest of all.

The rocks of the upper part of the Jawza suite in the Tagab-i-Jari extends as a narrow band in a south-eastern direction along the northern side of the valley. This

band is broken/ with an overthrust in the south, and with intrusions of plagioclase granite, breaking them, in the north. In a north -western direction it narrows gradually and pinches out tectonically; it widens up to 25 km to south-east and crosses the boundary of the investigated region. The total outcrop area in the region of the Tagab-i-Jari r. is about 28 sq. km.

I. Limestones - grey, dark grey - 40 m.

2. Albitophyres and plagioclase/ porphyres, more seldom -lava-breccias and tuff-lavas of the same composition, grey-green, with lighter spots, with subordinate beds of tufogenic sandstones, grey and greenish-grey, aleurolitic schists, grey, overlie the red argillites and aleurolites of the Permian age with angular / I5 -20°/ and azimuthal /up to 20°/ unconformity and small erosion pockets/ fig.9/. The apparent thickness is I000 m.

In the west, in the same level of the Triassic deposits, corresponding to higher parts of the section are cropping out / from the bottom/:

I. Albitophyres, tuff-lavas and lava-breccias of the same composition, grey-green, spotty- - 200m.

2.Limestones, light grey, sometimes - fine-pseudoolitic - 20 m.

3. Tuffs, tuffites, tuff-sandstones, tuff-aleurolites, red-brown with partings of greenish-brown and pinkish-grey lavas and lava-breccias of acidic and intermediate composition - 200 m.

The total thickness/ apparent/ is 420 m.

The total thickness of the sequence of the upper part of the Jawza suite, observed in the Tagab-i-Jari region, is I460 m., but in fact it exceeds this figure.

The described sequence resembles much the sequence of the same deposits, characterized faunistically and described above, in the region of Majed-i-Chobi, in spite of the sharply increased thickness.

The age of the upper part of the Jawza suite is ascertained as lower Triassic on the grounds of the finds of fossil fauna, given below in the description of the sequences. This fauna appertaines to the tops of the lower Triassic / to the Olenek stage/, according to the conclusion by B.K.Kushlin and A.S. Dagus, determined the fauna.

The character of this fauna/ammonoids, etc./ shows in contrast to lower Jawza age typically marine conditions of dwelling.

Depositions of sediments of the upper part of the Jawza suite took place in a comparatively shallow warm sea, abundant in volcanic islands, especially numerous in the esatern and south-eastern parts of the investigated area.

From the given descriptions and sequence comparisons / Fig.9/ one can see sharp increase of the thickness of the Jawza suite on the whole from west to east and, probably, from the north to south / more than in 3 times/ . The normally sedimentary rocks are more

and more replaced by effusive-tufogenic and then effusive-pyroclastic rocks .Local erosive-tectonic depressions, appeared in the epoch of the deposition of carbonaceous effusive-terrigene sediments of the lower part of the Jawza suite, probably, lost their sedimentative meaning in a considerable degree in the second half of the Jawza age.The accumulation of sediments and thick lavas was subordinated to the development of larger tectonic structures of regional meaning. In this period the eastern part of the investigated region differed essentially from the western one: the first one has a tendency to bowing/warping/ and was characterized by intensive show of volcanism, as the second one preserved stability and was characterized by the carbonaceous character of sedimentary accumulation.

CHAHAQ SUITE.

The Chahaq suite deposits are spread not so widely. They were ascertained in the Rod-i-Maluma valley, on its left watershed ridge with the adjoining valley from the west, and were supposedly distinguished on the southern slope of the ridge Selsela Koh-i-Band-i-Baba, in the upper course of the Rod-i-Darakht-Tut and north-east of the settlement Benosh-Darra

The deposits of the Chahaq suite are represented mainly by terrigene rocks: aleurolites, sandstones, more seldom-conglomerates. Thin lenses of limestones and green-blue tuffs are seen among them. Sandstones and conglomerates prevail in the upper part of the sequence. The strata are gray, brown-yellow to red-brown, sometimes-with violet hue.

The following rocks are typical of the Chahaq suite:

Sandstones, polymictic, gray, yellow-gray, yellow,yellow-red, red-brown, consist of medium- and badly rounded grains of quartz, feld spar, felsite;hornblende and plates of mica are in less quantity; oligomictic sandstones are more seldom with prevailing quartz. The sandstones are usually fine- and medium-grained, sometimes coarse-grained, compact with ferruginous-siliceous, sometimes-slightly carbonaceous/ dolomitic/ cement. Sometimes they contain rare admixture of gravel and small pebble.In some partings the sandstones contain up to 5-8% of tufogenic material, green-blue. Locally thin lamination is seen.In some differences of sandstones, mainly oligomictic ones, geodes up to 2-4 cm in diametre, filled with druses of quartz and calcite, are observed.

Aleurolites, polymictic, dark-gray, greenish-gray, brown-gray, sometimes-with violet hue, consist of badly and medium- rounded grains of quartz/20%/, argillite, jasper, albite,caolinized feld spars, seldom -of mica scales. They are cloddy or with pencil jointing. In some partings they contain sandy material. The cement is siliceous, slightly carbonaceous. Aleurolites prevail in thin lamination.

Limestones, gray, yellow-gray, often-sandy, compact, of compact structure, aphanitic, more seldom-micropseudooolitic /0.4-I.5mm/. The pseudoooolites amount to 80% of the rock. Sometimes separations of secondary quartz are contained.

They are platy, fine-grained, aphanitic.

Tuffs of quartzy porphyre, green-blue, green-gray, compact, consist of oxygonal fragments of quartz, acid plagioclase, felsite /0.1-0.5mm/ and quartz-sericite, slightly carbonatized main mass / little/.Sometimes slightly rounded grains are observed. They are compact, platy,lithoclastic, psammitic.

Conglomerates, fine- and medium-pebbly, gray, brown, compact. They consist of medium- and well rounded coarse gravels of quartz / prevails/, quartz-like sandstone, quartzy porphyre, red-brown sandstone. The cement is interstitial, more seldom-basal, sandy-gravelly-siliceous, sometimes slightly calcareous. The conglomerates contain lenses of sandstones, more seldom -of gritstones.

The rocks of the Chahaq suite lie conformably with underlying and overlying deposits.The dip angles of the beds range between 35-40 and 60-80°. Rare steep folds are seen.

The description of some sequences of the Chahaq suite is given below.

I. Thin uniform interbedding of aleurolites, gray, platy; sandstones,yellowish-gray, brownish-gray, fine-grained and more seldom-limestones,gray, brownish, often-sandy, platy. The beds are 5-20, more seldom-60-70cm.

Aleurolites, greenish-gray with rare interbeds of light gray pseudooolitic limestone prevail at the top. Rare interbeds / 0.5-0.8 m/ of green-blue tuff of the acid composition are among the aleurolites in the upper part of the band- 430 m.

2. Sandstones, yellow, medium-coarse-grained with dolomitic cement, with admixture of tufogenic material with geodes of quartz and calcite, measuring from I to 5 cm in diametre. Interbeds up to 3-4 m of limestone,yellow-gray, laminated, also with quartzy-calcitic geodes.At the top the same rocks are coloured into red-brown, contain lenses of gray-blue sandstone with admixture of tufogenic material-230 m.

The total thickness -660m.

Both of them overlie the limestones of the upper part of the Jawza suite conformably in the Rod-i-Maluma valley/fig.9/.

In the upper course of the Rod-i-Darakht-i-Tut river the deposits, attributed to the Chahaq suite conventionally, are represented by interbedding of sandstones,red-brown to black-brown with small pebble of Permian red minerals with rare beds of fine- and medium-pebbled conglomerates and greenish-gray argillites, compact with pensil jointing. Lenses of gray compact limestones are observed seldom. The apparent thickness is not less than 500 m.

North-east of the settlement Benosh-Darra/ 6-7 km/ at the mountain foot some outcrops of dark brown micaceous cloddy aleurolites, interbedding with fine- and medium-grained compact sandstones and subordinate conglomerates are observed above the limestones of the Jawza suite. The apparent thickness -200-250 m.

In the deposits of the Chahaq suite , in its upper part, in the region of the settlement Jawza the fossils, among which A.A.Shevirieff determined Tirolites sp., showing the Olenek stage of the Lower Triassic / Campille layers/, were gathered.

As the fossil fauna remains show, the deposits of the Chahaq suite are marine formations. Their accumulation took place in a shallow marine basin with normal salinity.

From the given sequences some coarseness of the material is seen in the direction from south to north, and appearance of red-brown colours in the same direction shows the nearness of the coastal line.

MIDDLE SECTION / T_2/.

The deposits of the Middle section are ascertained only in the Rod-i-Maluma basin, where they are traced in a north-eastern direction in a band , about I km in width, for 506 km in extent.

By the lithological features the deposits of the Middle Triassic are dismembered into two suites: kamarizard and sanjar.

Kamarizard suite /T_2 km/.

The deposits of the Kamarizard suite are represented mainly by argillites, aleurolites and to a lesser degree by sandstones with subordinate beds and lenses of limestones. The rocks are coloured in gray.

The following ones are the most characteristic:

Argillites, gray, greenish-gray, compact, cloddy, slightly calcareous, sometimes they are slightly micaceous, pelitic.

Aleurolites, polymictic, gray, greenish-gray, brown-gray, micaceous, sometimes-sandy, consist of badly rounded grains of quartz, plagioclase, mica scales, not very compact, cloddy, platy, sometimes -with thin lamination. Separate differences are gray-green, with admixture of tufogenic material / up to 8-10%/. The cement is quartzy-sericitic with admixture of carbonate.

Sandstones, gray, green-gray, sometimes-with red hue, polymictic, sometimes-tufogenic /up to 20% of tufogenic material/, fine- and medium-rounded, consist of poorly rounded grains of quartz , plagioclase, seldom-potassium feld spar, mica scales, sometims-fragments of argillite and felsite. The cement is porous argillaceous-siliceous, quartzy-sericitic, sometimes- with admixture of carbonate. They are psammitic.

Limestones, gray, light gray with violet hue, pinkish-yellow, compact, fine-grained, sometimes-aphanitic, with shelly break, sometimes- sandy, with admixture of green-blue tufogenic material /5-6%/. Small pseudooolitic, more seldom-organogenic-frag-

mental differences are seen. They are fine-grained, aphanitic.

The rocks of the Kamarizard suite lie conformably with underlying and ov overlying deposits. The dip of the beds is at angles from 35-40 to 60, seldom-80°.

The sequence in the Rod-i-Maluma basin / fig. 9/ has the following structure / / upwards/:

I. Limestones, light gray, pinkish, fragmental, highly sandy, sometimes-pseudo oolitic with admixture of bluish-green tufogenic material, platy, not clearly-bedde I0-60 m.

2. Argillites, gray, cloddy with partings of aleurolites and sandy limestones /I-2 m/, gray-yellow. Limestones, gray, sometimes-violet gray , compact , up to 5m thick, occur in the middle part. Gray aleurolites, more seldom- micaceous sandston es, sometimes- with red-brown hue, tufogenic, green-gray, micaceous, platy sandston es prevail at the top.- 420 m

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The total thickness is 430-480 m.

In the middle part of the sequence the following fauna was taken: Sturia sansc vinii /Mojsisovics/,Spiriferina fragilis /Schlotheim/,Sp.cf. manca Bittner,Sp.sp. ind.,Mentzelia koeveskalliensis Boeckh, Tetractinella trigonella /schlotheim/,Hirsu tella?sp.ind.

According to the conclusion by A.S.Daguis and A.A,Shevireff this fauna is characteristic of the Anazi stage of the Middle Triassic. Probably, The Kamarizard suite corresponds to the Anizi stage by its stratigraphic volume ,however, it is not confirmed as yet because of deficiency in organic remains.

The sediments of the Kamarizard suite were accumulated in the first stage in the conditions of a shallow insular sea, of which pseudooolitic limestones and li limestones with tufogenic material are indicative. The insular character of the marine basin was preserved, probably,later on , however, the supply of the terr igene material increased essentially due to energetic removal from land.

The deposits of the Kamarizard suite were not found in other parts of the investigated region, which is explained by deep erosion, proceeded to accumulation o of the upper Triassic and Middle Jurassic.

SANJAR SUITE /T_2 sn/.

The deposits, attributed to the Sanjar suite by us, were found only in the interfluve of the Maluma and Rod-iSanjur, north of the settlement Jawza, at an area of some square km / fig.9/. They are represented by strata of limestones, black-

minutely-nodular, bedded, in the bottom, light gray, pink or yellowish, fine-grained to aphanitic, compact, with shelly break, non-clearly laminated to massive - in the top. Their thickness reaches 410 m.

Organic remains were not seen in the limestones of the Sanjar suite and its Middle Triassic age is determined only by its position in the sequence; it lies conformably on the deposits of the Kamarizard suite, containing the fauna of the Anizi stage and trasgressively, with deep erosion, is overlain by the depesits, attributed conventionally to the upper section of the Triassic system.

The limestones of the Sanjar suite, with the exception of the very bottoms of the sequence, almost do not contain terrigene material. Probably, they accumulated in an open sea basins characterized by considerable depths / probably, half-pelagic area or the lower subzone of the neritic area/. They were not seen either as the sediments of the Kamarizard suite, described before, in other parts of the investigated region, because of Pre-Triassic erosion, destructed them completely.

UPPER /?/ SECTION / $T_{3/?/}$.

The deposits of the Upper /?/ section of the Triassic system are rather widely distributed than the sediments of the middle section. They are known not only in the interfluve of the Rod-i-Maluma and Rod-i-Sanjur, but also in the eastern part of the region, south-east of the coal deposit of Madjed-i-Chob-i. Their transgressive bedding on the underlying deposits is typical of them. first of all. There are no noticeable angular unconformities, but on the whole, the erodion , proceeded their deposition , is rather considerable. Due to it thick middle Triassic and partly lower Triassic deposits were destructed in the most part of the territory, as it was mentined before.

The character of the upper Triassic deposits in comparison with the lower and middle Triassic changes essentially: coarse-terrigene rocks of red colours prevail in the lower part of the sequence, lavas of the intermediate composition with a great amount of pyroclastic formations - in the upper part.

Definite organic remains were not found in the deposits, attributed by us to the upper section of the Triassic system. Their upper Triassic age is supposed on that grounds that they overlie unconformably the known middle Triassic deposits and are transgressively overlain by the sediments of the middle Eocene / Turkestanian stage/. At the same time these formations were not observed among Jurassic, Cretaceous and Paleocene deposits.

By the lithological features., the whole strata of the upper Triassic is divided by us into two suites: lower-Galasum/ effusive-terrigene / and upper one-Tutak /volcanogenic/,

GALASUM SUITE /$T_{3(?)}$ gl/.

The deposits of the Galasum suite are developed in the environs of the settlement Gala Sum, and also in the east of the region, in the basin of the Darra-i- Marghozor. They overlie different sediments of Triassic age with inconsiderable angular unconformity, but with deep erosion. In the region east of the settlement Gala Sum they overlie together with basal conglomerates the deposits of the Sanjar, Kamarizard and Chahaq suites, gradually cutting them [illegible] in a north-eastern direction / the summary thickness of "the cut" Middle-Lower Triassic sediments for a distance of 6-7 km, is about 1000m/. In the east of the region ,in the Darra-i-Marghozor basin they overlie also with erosion immediately the deposits of the Jawza suite of the Lower Triassic.

The deposits of the Gala Sum suite lie more often monoclinally with dip angles of the beds from 20 to 40 , seldom-50-60°.

In the region of the settlement Gala Sum / fig. 9/ in the base of the Galasum su: suite conglomerates of non-persistent thickness from 5-10 to 20m, composed of medium- and poorly rounded coarse gravels of different sizes, and also small boulders of different limestones, gray sandstones, red sandstones / like Permian ones/, quartzy porphyries , dark green basic effusions, quartz,etc, cemented with sandy-argillaceous, slightly calcareous cement, lie.

Over the basal conglomerates thick strata of interbedding sandstones, conglomerates, gritstones, red-brown-gray, lie. The composition of the conglomerates is the same as those which were described before, but usually without boulders and only seldom with coarse gravel fragments. Sometimes beds of claret-red and malachite-green aleurolites are observed.

The latters contain considerable admixture of volcanogenic material /up to 50%/. Rare thin / down to 2 m/ interbeds of limestones, aphanitic, violet-gray, often aleurmitic/ up to 25% of aleurite/ are seen in the middle and lower parts of the sequence. Beds of dark gray-green effusions of the andesito-basalt composition occur near the strata base, and those of greenish-gray, violet-gray andesites near the roof.

The total thickness of the Galasum suite is not less than 1300 m.

On the whole, frequent facial replacements of some rocks with others and frequent change of rocks along the sequence without any noticeable regularities. are typical of the described strata.

In the region of the Darra-i-Marghozor the Galasum suite is composed of finer-fragmental rocks: argillites, aleurolites, sandstones and seldom- conglomerates,dark claret-red. Limestones / usually from gray-violet to violet-red/ make up rare thin bed.

The apparent thickness of the Galasum suite in this region is about 800 m.

The sediments of the Galasum suite deposited in a water basin, of which plateax of limestones are indicative. The character of the sediments, especially in the region of the settlement Gala Sum, is typical of coastal, probably, deltaic formation to a considerable degree, the deposition of which took place in incensiderable remoteness of removal sources.

Apparently, the sediments of the Darra-i-Marghozor region correspond to deeper-watered and more remote sections of the basin from land.

TUTAK SUITE /$T_{3(?)}$ tt/.

The formations of the Tutak suite were widely developed in the region of the settlement Tutak / south of the settlement Maluma/. In the region of the settlement Tutak /fig. 9/ the formations of the Tutak suite overlie the deposits of the Galasum suite without visible conformity. Their upper boundary was not observed because of the transgressive overlap of the upper Eocene with sediments / Turkestanian stage/.

The rocks, composing the Tutak suite, are represented exceptionally by trachytic and andesitic lavas and more seldom-their pyroclastic compounds. The andesitic lavas prevail.

The description of the rocks, most spread among the deposits of the Tutak su suite, is given below:

Trachytic blister lava, greenish-gray, gray, more seldom-brownish-gray, unequally coloured. Seldom- biotite, small laths of andesine in the main mass, little alkaline feld spar, crystalline glass, carbonate, sometimes-quartz are in impregnations of plagioclase No.40, measuring up to 10 mm. The amygdules, rounded in form, are filled with calcite, more seldom-chalcedon and chlorite. Sometimes plagioclase is wholly replaced with analsite. The rock is porphyric, sometimes-relict; the main mass is trachytic, sometimes-also relict.

Andesitic lava, gray-green, more seldom-black-green or brown-green, compact Zonal plagioclase /No.40/, measuring 3-8mm up to 30% and single augite crystals are in impregnations. Laths of plagioclase, seldom-augite, poorly crystalline glass, carbonate, seldom-quartz / secondary/ are in the main mass. The rock is porphyric; the main mass is hyalopelitic.
Some differences are slightly amygdaloidal. The amygdaloidal separations are rounded in form, measuring up to 1.5-2 mm and are filled with calcite, chalcedon or chlorite.

Tuff-lava of trachytic composition /ignimb rites/, gray, pinkish-gray, green-gray; the rocks are compact, consist of sintered fragments of trachyte/0.1-0.4 mm/, plagioclase/ oligoclase-andesine/, little quartz, separations of ca carbonate and ore minerals are observed. They are psammitic, crystallolithoplastic.

Lava breccia of andesitic composition, gray-green, brown-green, unequally coloured. The rocks are compact, sometimes they are cloddy on the weathered

surface, consist of andesine fragments , measuring up to 5-6 cm,contained in the lava of andesitic composition.
Probably,other structural compounds can be distinguished among pyroclastic compounds of lavas.

All the rocks are uniform in their outward appearance,they are massive,or of not clear structure, compose bands, from 5-I0 to 50-70 m in thickness. The contacts of such bands are usually not clear. Pyroclastic formations are distinguished from lava with difficulty often.

The non-total thickness of the Tutak suite in the region of the settlement Tutak reaches 1000 m.

Lava flow and formation of pyroclastic rocks, probably, took place in water conditions, at any rate in the initial stages of the formation of the Tutak suite. The concordant contact with the underlying strata, which is of a shallow origin and contains small flows of lava of the same composition as that of the Tutak suite in the upper parts of the sequence ,confirms it.

Final stages of eruptions, probably, took place in sub-earial conditions.

JURASSIC SYSTEM / J/.

MIDDLE SECTION/DOGGER/.

In the investigated territory the Jurassic deposits are represented by the middle section only. They crop out in a very limited area / altogether about 2.5 sq.km/. on the southern slope of the ridge Bandi-Badghisat in the upper reaches of the Rod-i Karukh valley. The outcrops of the middle Jurassic deposits are traced in a band from I500 to 3500m in thickness, of a sublatitudinal direction for an extent of about II km from the upper reaches of the Rod-i-Madjed-i-Chob-i in the east / where coal openings are located/ to the confluence of the streams Darra-i-Abdol Khana and Darra-iChashma-i Safed in the west.

The distribution of the middle Jurassic deposits in the east and in the west is sharply limited by rupture dislocations of Pre-Albian age.

A small outcrop of the same middle Jurassic deposits is observed on the left slope side of the Rod-i-Madjed-i-Chob-i valley, I.2 km south of the settlement Hamam. This outcrop has a width of about 200m and an extent of less than I km and is wedge scales in the zone of the overthrust of a sublatitudinal strike.

The middle Jurassic deposits overlie the lower Triassic sediments and red deposits of the Permian age with erosion and angular unconformity and in their turn they are overlain by terrigene-carbonaceous deposits of the Albian stage of the Lower section of the Cretaceous system with stratigraphic unconformity.

The Triassic deposits, underlying the middle Jurassic, are developed mainly in the east/ the region of the upper reaches of the Rod-i-Madjedi-Chob-i/, in the west the Triassic deposits are observed as small erosive / till middle Jurassic/ remains(outliers) or they are quite absent and then the sediments of the middle Jurassic overlie immediately the red minerals of the Permain age.

Unconformity between the sediments of the middle Jurassic and the Triassic and Permian deposits, underlying it, is strongly pronounced and is of the angular as well as of azimuthal character;at the same time the rocks of the Albian stage overlie the Jurassic with a slight angular unconformity / up to 2°/, which can be ascertained only on the grounds of geological mapping.

The deposits of the middle Jurassic age are represented by non-carbonaceous rocks: aleurolites,argillites, more seldom-sandstones, gristones and subordinate accumulation of vegetative carbonificated material as fine-disseminated inclusions / coaly argillites/,microlenses, thin partings and seldom as lens-like accumulations ,up to I-2.5m thick.

The distribution of the above mentioned varieties of rocks in the sequence is characterized by considerable inpersistency in composition and thickness. It is well seen in the example of two relief columns, given in fig. . However, some regularities, consisting,first of all , in repeatedness of similar combinations of beds, replacing each other in a definite order and corresponding to the rhythms of sedimentation,can be determined at detailed studying the sequence of bedding the rocks in the vertical section.

I0-II rhythms of this kind can be distinguished with a thickness from 3.2m to I3.7 m, the rhythms with minable accumulations of coal being the thickest.

The most characteristic lit-by-lit sequence of the middle Jurassic deposits, made on the right side of the Rod-i-Madjed-i-Chob-i valley, [illegible] in the central area of the coal deposit, in the region of old coal workings / fig.I0/.

Here on the tufogenic sandstones and tuffs of the Lower Triassic age / the lower part of the Jawza suite/ lie with unconformity:/rhythms are numerated with Roman numerals, and beds-with Arabic figures/

I	I. Aleurolite, sandy, gray, slightly carbonaceous	2.0 m
	2. Sandstone, quartzy, medium-grained	0.60 m
	3. Argillite, carbonaceous, dark gray to black with interbeds of bright coal from 3 to 5 seldom-I5 sm /"puffy pastry"/	2.00 m
I	4. Aleurolite, sandy, greenish-gray	2.80 m
II	5. Sandstone, quartzy, fine-grained with inclusions of small fragments of bright coal . . .	I.70 m
	6. Aleurolite, greenish-gray with interbeds of fine-grained sandstone	5.20 m

II	7. Argillite, dark-gray with carbonificated vegetative detrite and rare thin lenses of bright coal	2.00 m
	8. Argillite, dark-gray with lenses of bright coal from 5 to I0cm	2.30 m
	9. Aleurolite, carbonaceous, dark-gray with lenses of bright coal up to I mm	2.50 m
	I0. Clay, poorly carbonaceous, compact, fat, gray with thin lenses of bright coal / up to I mm/	0.50 m
	II. Coal, banded, bright and half-dull	0.80 m
III	I2. Argillite, gray, poorly carbonaceous, foliaceous, with rare interbeds of aleurolite and bright coal up to 5 cm	5.I0 m
	I3, Argillite, dark gray, poorly carbonaceous with interbeds of aleurolite and bright coal from 0.5 to 3cm. Lenses of fine-grained sandstone are in the base	4.50 m
	I4. Sandstone, quartzy, medium-grained, light gray	0.40 m
IV	I5. Aleurolite, poorly carbonaceous, gray	0.70 m
	I6. Argillite, dark gray with rare interbeds of aleurolite	2.90 m
	I7. Sandstones, quartzy, inequigranular, fine-grained with argillaceous-siliceous cement	2.00 m
V	I8. Aleurolite, dark gray with charred vegetative detrite and interbeds of fine-grained sandstone up to I0 cm	7.80 m
	I9. Sandstone, similar to the sandstone of layer I7, gravelly material is contained in the layer soil	I.00 m
VI	20. Aleurolite, gray, with inconsiderable admixture of charred vegetative detrite with sandstone interbeds, up to I0cm thick	5.20 m
	2I. Sandstone, medium-grained, light gray	2.00 m
VII	22. Aleurolite, poorly sandy, gray	I.20 m
	23. Gritstone, quartzy, gray, trasforming into sandstone	0.70 m
	24. Aleurolite, gray, poorly carbonaceous, with sandstone interbeds	0.80 m
	25. Sandstone, quartzy from fine-to medium-grained, light gray	0.40 m
VIII	26. Aleurolite, gray, poorly carbonaceous	I.30 m
	27. Sandstone, quartzy, from fine- to medium-grained, compact, light gray	I.40 m
	28. Aleurolite, gray with thin interbeds of fine-grained sandstone and lenses of bright coal up to 3 cm	7.30 m
IX	29. Sandstone, fine-grained to short-grained, brownish	0.60 m
	30. Argillite, gray, fragmental with rare carbonificated vegetative detrite	0.40 m

X	31. Coal, banded, bright and half- dull	0.10 m
	32. Argillite, poorly carbonaceous, compact, gray, with fine carbonificated vegetative detrite	3.00 m
	34. Sandstone, quartzy , medium-grained, yellow-gray	0.50 m
	33. Aleurolite, with interbeds of sandstone with gravelly material	1.00 m
XI	35. Sandstone, quartzy, fine-, medium-grained with admixture of gravelly material, compact	0.70 m
	36. Aleurolite, gray with interbeds of fine-grained sandstone	0.80 m
	The total thickness	80.00 m

Gravelly and pebbly conglomerates of the Albian stage lie over without visible unconformity.

In the described sequence there are 57% aleurolites, 28% argillites and carbonaceous argillites, 13% sandstones and gritstones, 2% coal by their thickness.

1 km north-west in the north-western section of the coal deposit another sequence of the middle Jurassic deposits was studied in details. The relief column of this sequence is given on fig. 10, section 15.

As a whole, by the combination of lithological differences of the rocks and sequance of their alternation, this sequence differs little from the before described. Some rhythms, distinguished before, can be ascertained here. It favours the possibility of comparing the sequences, at any rate those, which are located at little distances. It is possible practically and we shall deal with it later on in the section "Coal presence".

In the sequence of the north-eastern section of the coal deposit the correlation of the rocks of different granulometric compositions changes in comparison with the described before: The amount of argillites and carbonaceous argillites, which are 34% by thickness, increases sharply and correspondingly the amount of aleurolites decreases down to 50%. The summary thickness of sandstones and gritstones somewhat increases and amount to about 3%. This increase takes place because of the increase of thin interbeds / from 5 to 15 cm/. The total thickness increases up to 96.75 m, perhaps, due to higher parts of the sequence / about 30 m/, which appear here because of an unconformable overlap of the Jurassic deposits with Albian conglomerates. This angular unconformity does not exceed 2° here, apparently.

In a western direction from the above described sequences the middle Jurassic deposits are poorly exposed. Judging by some outcrops one can suppose that the general character of the sediments changes in a western direction: the role of

argillites and aleurolites increases and the total coal saturation of the deposits decreases.

In the marginal western parts , along the valley, located east of the Darra-i-Abdol Khana on light tuffs of the Lower Triassic age(the Lower part of the Jawza suite lies with poorly expressed unconformity :

I. Sandstone, quartzy, fine-grained, compact, white, with limonitic concretion irregular in form, with voids inside, filled with white quick sand	3.00 m
2. Clay, compact, gray, cloddy with interbeds of aleurolite with fine vegetative detrite. Interbeds of carbonaceous clay, dark gray ,with lenses of bright coal, up to 2-5 cm in thickness and limonite concretions -in the top	22.00 m
3. Sandstone, quartzy, fine-grained, gray	0.50 m
4. Interbedding of compact clays, similar to the ones, described in layer "2", with aleurolites.Carbonaceous clays, with thin lenses of bright coal are in the top	27.00 m
5. Sandstone, quartzy, fine-grained, greenish-gray, with aleurolite interbeds	0.30 m
6. Clay, compact, dark gray with interbeds of aleurolite, argillaceous ,up to 0.6 m thick, Clay,carbonaceous, dark is in the top	20.00 m
7. Sandstones, quartzy, inequigranular ,from fine- to medium-grained, with rare gravelly material	0.40 m
8. Aleurolite, gray with greenish hue, platy	3.50 m
9. Clay, consolidated, black, with rare lenses of bright coal, up to 3 cm thick	0.50 m
I0. Aleurolite, argillaceous, gray, with partings of gray aleuritic compact clay	II.00 m
II. Clay, compact with small carbonificated vegetative detrite	8.00 m
I2. Aleurolite, argillaceous, similar to that in layer I0	6.30 m
I3. Aleurolite, argillaceous, greenish-gray	2.50 m
The total thickness	I03. 00 m

Over,conglomerates and limestones of the Albian stage lie without visible unconformity.

The described sequence, probably, characterizes the section of depression, during which the accumulation of coal-bearing sediments of the middle Jurassic took place, more remote from removal sources .

As a whole, thickness change of some layers and often lens-like character are

comparatively quick submergence of spatial territory. This submergence had a epi rogenetic character.

Rather small territories of the distribution of the middle Jurassic deposits in the studied region are conditioned by tectonic movements of post-Jurassic age, which were of the disjunctive character, and the following erosive-denudation processes ,preceeded the trasgression of the Albian sea.

CRETACEOUS SYSTEM.

The Cretaceous system with in the limits of the Described territory is represented by both sections. The Cretaceous deposits are developed in the northern part of the region at an area of 450 km^2. They compose a narrow band /0.5-3 km/extending in an almost latitudinal direction along the southern slopes of the Selsela, Kohi-Bandi-Baba and Bandi Baba sato ridges. The Cretaceous deposits crop out north of these ridges: in the north-west of the region- in the upper reaches of the left tributaries of the Kusk, in the north-east- in the Laman basin.

The Cretaceous deposits lie discordantly on the older formations and are overlain conformably by Paleocene.ones. Usually they lie gently ,sometimes forming folds with dip angles of the beds in the wings up to 20-30° and only in the near-fractured zones they lie steeply,up to overturned occurrences.

The following formations are distinguished among the Cretaceous deposits:Albian, Cenomanian and Turonian,Coniacian,Santonian and Campanian,Masstrichtian, the lower part, Maastrichtian, the upper part, and Danian stages /fig.II/.+

LOWER SECTION

ALBIAN STAGE /Cr,Al/

The Lower section of the Cretaceous system in the studied region is represented by one Albian stage. It comes out to the day in all the mentioned places of the Cretaceous deposits distribution.

The Albian stage is represented by terrigene-carbonate strata,composed of limestones,marls,clays,sandstones and conglomerates.The description of the rocks, composing the deposits of the Albian stage, is given below.

The limestones are brownish-,brownish-gary,gray,sometimes black. There are fine- and medium-grained differences ,rarer- aphanitic,among them. They often contain fine organogenic detritus and are organogenic-fragmental with fragments of pelecypod tests, bryozoans /up to 50%/. The presence of fine-oolitic limestones with separate spheric or oval oolites,measuring up to 0.5 mm/rarely- complex/and micrograined partly argillaceous calcite,filling the space betweem them/fig.2/.

+ We have not made a more detailed sequence of the Cretaceous system/taking the work scale in consideration/ as there are only rare finds of fossil,lithological monotony and comparatively small thickness of some stages,often cropping out in precipitous slopes.

Sometimes the limestones are sandy-gravelly / grains of glauconite, quartz, sericitized feldspar, fragments of acid effusive rocks/, often- aleurite-micaceous/ grains of quartz, muscovite scales/, or argillaceous. As a rule, they are fine- and medium-bedded, more seldom-non clearly-bedded, or cloddy, massive, platy. The limestones compose bands up to 20-30 m or single interbeds, 0.1-2 m thick.

Greenish-brown, light-brown marls are of a subordinate meaning. They are composed of micrograined argillaceous-calcitic mass, quartzite grains are pelitized. They are often argillaceous, aleuritic/quartz grains up to 0.02 mm/, micaceous, fine-bedded, thin-platy.

The clays compose bands, up to 90 m in thickness. They are green-gray, dark gray, more seldom they are black, small-tabular or foliaceous, soft, sometimes they are limy, micaceous.

The sandstones are fine-grained and the aleurites are light-gray or red-brown. They are oligomictic, essentially quartz rocks with an inconsiderable quantity of muscovite flakes, feldspathic grains and fragments of acid effusive rocks. The grains are of middle size, half-rounded. The pore cement is calcitic or argillaceous-calcitic or muscovitic-quartz cement of caving. Sometimes the rocks are ferruginized and brown. Lenses and interbeds of quartz gritstones are seen among them.

The conglomerates are brownish-gray, light gray and are observed in some sections. They are fine-pebbly and medium-pebbly, quartzy with well rounded and sized pebble. The cement is sandy-argillaceous-carbonate, irregularly grained. Brown-black limy conglomerates with small pebble of limestones and glauconitic-sandy-calcitic cement are seen in the same section.

The section, observed in the upper reaches of the Darya-i-Tagab Laman, described upwards, characterizes the interrelations of the Albian formations. /fig 14-20/

1/ Light gray quartzy conglomerates and gritstones with interbeds of sandstones. . . . . visual thickness-6.0 m.

2/ Black organogenic-detritic, oolitic limestones with argillaceous interbeds - 25.5 m

3/ Gray schistose clays with limestone interbeds . . . . . - 22.0 m

4/ Grayish-brown organogenic-detritic limestones . . . . . -3.5 m

5/ Dark gary, black clays . . . . . .3 .0 m

6/ Greenish-gray clays with sandstone interbeds . . . . . -22.0 m

7/ Sandy limestone, turning into sandstone . . . . . 13.0 m

8/ Greenish-gray argillaceous marls . . . . . -10.0 m

The visual thickness of the Albian deposits is 95 m. The Cenomanian and Turonian deposits overlie them /probably, with inconsiderable erosion/. The underlying sections of the deposits are not stripped, however, bed No 1 is attributed to its base, probably, if not to the basic horizon. Thus, white, light brownish-gray gritstones and sandstones, quartzy, micaceous with argillaceous-calcitic cement, 27.5 m in thickness/ underlying fine-oolitic detritic limestones/ overlie the Jurassic deposits, 6 km south-west of the described area, behind the pass Sabzak.

However, the basic horizon, represented by fragmental deposits, are seen only in some places. For example, brownish-gray limy aliurites and marls /visual thickness-6 m/, turing inte oolitic limestones overlie the Jurassic strata, 7 km southeast of the descrit section, east of the coal deposit Masjid vobi.

There are no fragmental deposits in the section base ment west of the Sabzak pass. Blafine-oolitic or fine-crystalline limestones, containing only interbeds /up to 3 sm/ with rare small pebble of the Permian red rocks lie on the northern slope of the Darrah-i-Gazak.

The section of the Albian deposits has the following structure in 5 km north-northwest of the settlement Dalantu. /upwards/; /fig. I4/

I/ greenish-brown, brownish-gray, argillaceous, aleuritic limestones - visual thickness 4m

2/ brownish-gray argillaceous limestones with interbeds of black oolitic ones . . .. ;-6.4m

3/ Gray, greenish-brown marls with interbeds of black oolitic or organogenic fragmental limestones with Haustatorsp., Pterotrigonia aff. aliformis Park., Lima sp., Modiolus sp., Hypacantheplites sp. 25.0m

4/ Black oolitic limestones with interbeds of organogenic-fragmental ones with Pterotrigonia aff. aliformis Park., Chlamys sp; . . . . . -2.0m

5/ Gray, dark gray, organogenic-fragmental limestones with clay interbeds 88.3m

6/ Greenish-, yellowish-brown, argilliaceous limestones with interbeds of limy conglomerates and greenish-gray clays . . . . . -4I.7m

are in contact with the Permian deposits along the fracture.

The fossils are: Colombiceras sp., Amphidonta ex. gr. latissima Orb., Corbula gaultina Pict. et Camp., Pinna robinaldina Orb., Crammatodon cf. carinatus Sow., Pholadomya sp., Leda sp., Thetironia sp.

The Maastrichtian and Danian deposits lie discordantly higher. The total thickness of the described deposits is I27.4 m. The similar section is observed west of the described one, on the right bank of the Rodi-Darakhti-Tut. /fig. I4/.

The section of the maximum thickness is observed /Cherkessoff O. V. etc, I962/, south of the settlement Khwaja-Sahab. /fig. I4/.

I/ Gray, dark gray limestones . . . . . 20.0 m

2/ Gray clays with limestone interbeds . . . . . 26.3 m

3/ Dark gray oolitic limestones . . . . . 2.5 m

4/ Gray clays . . . . . I2.8 m

5/ Gray oolitic limestones . . . . . 4.0 m

6/ Brownish-gray aleuritic clays . . . . . I4.5 m

7/ Gray limestones . . . . . 2.5 m

8/ Greenish-gray, dark gray clays with limestone interbeds with Neohibolites cf. styloides Pewg., Linotuigonia sp., Douvillicers mammillatum /Schloth./, Beudaticeras cf. cigatum /Mewtet Ink-BW$_I$/ . . . . . I02.6 m

overlie the Permien deposits transgressively.

Seam 8 is attributed to the upper and middle sub stages, seams 4-7 -to the lower substage of the Albian stage. Stage I-3 is attributed to the Aptian stage by Cherkesoff O. V. However, the fossils, found by him, are indicative of the Albian age of seams I-3. In this case the total thickness of the deposits of the Albian stage is 385.2m in the described sequence.

The cited determinations of the fossils confirm the Albian age of the described deposits, most likely the middle - and upper Albian age. The Albian stage is present in its whole volume only south of the settlement Khwaja-Sahab.

The Albian deposits overlie the Permian, Triassic or Jurassic deposits transgressively with sharp discordance. The Senomanian-Turonian overlie them /probably with inconsiderable erosinn/ or the terrigene Mastrichtian and Danian deposits overlie them with sharp stratigraphic disconformity.

The thickness of the Albian deposits changes slightly by area, increasing from I00-I20 m /in the region of the pass Sabzak/ in a western direction, reaching I40-I85m at the settlement Khwaja- Sahab.

The character of the described deposits is indicative of their accumulation in littoral and neritic zones of the marine basin, which is shallow and warm, corresponding to the

beginning of the marine transgression. Sedimentation took place ,probably, in the margin al part of the basin. The lithological composition of the deposits,thickness increasing /up to 457 m/ north and north-west/ Chepoff Ju.P.,etc,1961/ and appearance of the Lower Albian substage/Ivanoff S.D.,etc,1961/in the section at the settlement Khwaja-Sahab and north of it,and also the absence of the Albian/and of Cretaceous in general/ deposits in the southern part of the studied area on the ridge Selsela Koh-i-Dawinder/point to it.

One can suppose that the land was situated immediately south of the southern outcrops of the Albian deposits,observed at present, i.e. the shore line passed along the modern southern slopes of the Selsela-Koh-i-Band-i-Baba and Khwaja -Abdal.

UPPER SECTION.
/Cr_2/

The Upper section of the Cretaceous system is represented by all the stages, developed in the north-western and north-eastern parts of the territory of the described region.

The Cenomanian and Turonian stages, non-divided /Cr_2cm+t/

The Cenomanian and Turonian deposits are most widely developed in the Laman basin. They are also observed south of the Sabzak pass and northwest of the region, along the left tributaries of the Kushk.

The carbonate-argillaceous strata of the Cenomanian and Turonian stages are represented by clays,marls and limestones.

The most typical of them are:
Greenish-gray,gray,more seldom dark gray or black clays prevail in the sequence. They are foliaceous,flaky or fine-lumpy,often dense, schistose. The clays are usually calcareous,aleuritic,micaceous differences are seen.

Greenish-, brownish-gray marls usually compose interbeds among the clays. Their main mass is micro-grained, and is composed of approximately equal quantity of small grains and flakes/0.01 mm/ of the pelitized calcite and argillaceous minerals. Frequent /15-30%/ aleuritic/upto 0.03-0.05 mm/ grains of quartz,calcite,glauconite,more rarely of feldspar,separate muscovite flakes,small ostracod tests are seen in it. The structure is disorderly. The marls are thin-bedded and are characterized by thin-tabular jointing,massive differences are observed more seldom.

Greenish-gray,brownish-gray limestones are represented by some differences. They are fine- and micro-grained rocks,sandy-aleuritic,micaceous, often with organogenic detritus. Their main mass is composed of isometric grains/measuring 0.05-0.2 mm or about 0.01 mm/of calcite, slightly pelitized ,with frequent /up to 15-20%/ fragments of bryozoans,pelecypodcoquina,ostracod/?/. Single rounded grains of glauconite and semi-rounded grains of quartz,measuring up to 0.07mm are seen. The structure is disorderly.Argillaceous differences are also observed.All the limestones are thin-bedded, with thin- and unequally-tabular jointing.

We can judge about the texture of the described strata by the sequence, observed 8 km north-northeast of the pass Sabzak. /Fig 6;20/

I/ Dark greenish-gray micaceous marls; argillaceous marls, clays. Interbeds of sandy limestone; the basic interbed-with glauconite and phosphorus. Inoceramus ex gr. labiatus Schloth., Amphidonta aff. columba, Lam., Spondylus sp. were found in the band base from the hill waste. . . . -38-50.0 m

2/ Gray, brownish-gray fine-grained limestones with aphanite interbeds . . . -8.5 m

3/ Greenish-gray, sandy, argillaceous limestones . . . . - 15.0m

4/ Greenish-gray fine-grained limestones, containing /approximately 5m/ the fossils of the Lower Coniacian substage in the upper interval, and under it -the fossils of the Upper Turonian substage: Inoceramus ex gr. Kleini Miill., In. cf. undulatus Mant., Amphidonta sp. . . . . - 15.0 m overlie the Albian deposits, probably, with inconsiderable erosion.

The Turonian limestones form rocky benches in the relief.

The total thickness of the Cenomanian-Turonian deposits is about 80 m.

1/ GREEN-gray, sandy, glauconitic limestones . . . . . 2.0 m

2/ Greenish-gray argillaceous limestone 40,0m

3/ Brownish-gray fine-grained limestones I.0m

4/ Greenish-brown argillaceous marls . . . . . 70.0 m

5/ Brownish-gray fine-grained limestones with Inoceramus aff. labiatus Schloth., In. aff. falcatus Neinz, In. cuvieri Sow., In. aff. striato-concentricus Gumb., In. sp., Arkhangelskiceras sp., ...I0.0 m

6/ Greenish-brown, greenish-gray, argillaceous marls with Gryphaea vesiculosa turkestanica Bobk., Inoceramus aff. striato-concentricus Gumb. . . . .25.0 m

outcrop over the turfed foot on the southwest side of Darrah-i-Gazak, in the upper reaches of the Gurge gorge. /Fig 6;29

The Maastrichtian and Danian deposits overlie them with azimuthal and angular discordance/fig 44/. The total thicknes of the described deposits is I46m/seamI is, probably, attributed to the Albian stage/.

The similar character is typical of the Senomanian-Turonian deposits of the northern slope of the ridge Selsela-Koh-i-Band-i-Baba. The following sequence is observed south of the settlement Khwoja-Sabah/Chepoff Ju.p., etc., I96I/.

I/ Dark gray clays with limestone interbed in the basement. . .20.0 m

2/ Gray limestones with Mantelliceras mantelli Sow., . . .2.0 m

3/ Dark gray clays, slightly sandy . . .9I.I m

4/ Dark gray cryptocrystalline limestones . . .I5.0 m

overlie the Albian deposits.

The Cenonian marls overlie them. The total thickness of the described deposits is 128.I m.

The position of the considered deposits in the section/overlie the Albian deposits

are overlain by the Coniacian deposits conformably/ and also the gathered fossils/besides the mentioned above-Inoceramus apicalis Woods,In.aff.Annulatus Goldf.,Gn.lusatiae Andert.,Hemiaster aff.nucleus Desor,Mammites/?/sp./ are indicative of their Turonian age. Probably, both substages of the Turonian stage are present.Negligible erosion in the basement of the considered strata/overlying the Upper Albian substage/,slightly noticed in most sections or not noticed at all,allow to suppose that the Senomanian stage is present in it,though partly.The find in the basement of one of the sections Amphidonta aff.columba Lam./of the Senomanian-Turonian form/ confirm the latter fact.

The thickness of the Cenomanian-Turonian deposits increases westward,from 80 m/the Laman basin/ to I20-I40 m on the western termination and northern slopes of the ridge Selsela Koh-i-Band-i-Baba. The minimum thicknesses of the Cenomanian-Turonian deposits /80-60m/ are seen along the southern slope of the ridge Khwoja Abdal. The facies composition of the deposits does not change practically by area.

The Cenomanian-Turonian deposits formed in a shallow marine basin, undergone inconsiderable fluctuations of the level only in the Cenomanian age,probably.

Santon, Coniacian and Campanian stages non-divided /Cr_2cn+st+cp/.

The Coniac-Santon-Campanian deposits outcrop in the Laman basin,in the band,passing through the pass Sabzak and in the north-west of the region,along the northern slope of the ridge Selsela Koh-i-Band-i-Baba.

From the lithological point of view this is an uniform carbonate strata,consisting of limestones,marls,clays and aleurites.

Limestones,greenish-brown or brownish-gray ,are seen by interbeds ,up to I5 m thick, only in the basement of the section.They are fien-grained/the main mass is composed of angulai ometric grains of slightly pelitized calcite,measuring from 0.03 to 0.05mm or 0.05-0.2mm aleuritic /up to 5% quartz grains and glauconite grains,measuring up to 0.03 mm/,sometim they contain organogenic detritus,thin-bedded with thin- and unevenplaty jointing.

Marls,greenish-,bluish-,brownish-gray,prevail in the section. Their main mass is micrograined,argillaceous-calcitic/the calcite is pelitized / contains rare aleuritic grains of quartz and glauconite. The rocks are thin-layered,thin- and unevenplaty, with shelly,chip-like,spheroidal jointing.

Clays,light gray,highly calcareous,argillaceous,thin-bedded,thin-platy. Aleurites / /and clays/ are seen only by separate interbeds among the marls.

The section,observed along the eastern and southern slopes of the Laman basin, has the following structure /upwards/, /Fig. 6,24/

1/ Greenish-gray limestones with Inoceramus cf.lusatiae Andert,In.cf.schoenbachi Boehm., In.aff.wandereri Andert,In.cf.inconstans woods in the Upper interval ,5 m thick /under them-the fossils of the Upper Turonian substage/ . . . I0-I5.0 m

2/ Light brown marls with limestone interbeds . . . 20-50.0 m

3/ Greenish-gray limestones,fine-grained with Inoceramus aff.sertzi And.,In.Lusatiae And

In.aff. schloenbachia B ahm. . . . . I0-15.0 m

4/ Greenish-,bluish-gray marls,replaced along the strike by limy aleurites or clays. Grypfaea vesicularis Lam.,Exogyra decussata Goldf.,Discoscaphites/?/sp. are seen in the upper part,Spondylus striatus Goldf.,Inoceremus haenleini Muld,In.aff/dariensis Dal Labr.,"Nautilus"sp. . . . . .165-200.0 m.

The Maastrichtian deposits overlie them conformably. The total thickness of the considered deposits is 220-270 m.

The following section south of the settlement Khwoja-Sahab is described /Chepoff etc.,1961/. I/ Dark gray,slightly sandy marls . . .7.5 m

2/ Dark ,dark gray,slightly sandy limestones . . .I8.8 m

3/ Dark gray sandy clays . . . 7.0 m

4/ Gray fine-grained clays with Gewosiceras amudariensis Iljin,Inoceramus sp.,Baculites sp., Nautilus sp., Spondylus sp., Cardium sp. . . .I0.0 m

5/Grayish-brown sandy clays with Inoceramus sp., Baculites sp. . . 7.0 m

6/ Gray marls gray limestone in the roof.The fossils:Spondylus spinosus /Sow./,Spondylus cf.striatus Goldf.,Spondylus sp., Inoceramus sp.1,2,Exogyra sp., Terebratula sp., Gryphaea sp. . . . . .28.5 m

7/Gray ,dark gray marls with Spondylus cf.striatus Goldf., Spondylus spinosus/Sow.,Lophe cf.semiplana/Sow/.,Inoceramus ex gr.balticus Bohm.,Baculites sp.,Cyclothyris sp.,Texanites sp., Ostreasp.,Lima sp. . . . . .44.0 m

8/ Greenish-gray sandy clays . . . . . .53.8 m

The Maastrichtian and Danian deposits overlie them discordantly.The total thickness of the deposits in the given section is I75.8 m. One can suppose that the upper part of seam 8 belong to the Maastrichtian stage,as Gryphaea vesicularis Lam.,Chlamys sp.,Spondylus sp. were found by us.

The mentioned fossils,and also the gradual transition of the considered deposits to Senoman-Turonian and Maastrichtian are indicative of their Coniac-Santon-Campanian age. All the three Lower stages of the Senonian deposits are present in the section /besides the north-western part of the region/.

The maximum thickness /270 m/ of the Coniacian-Santonian-Campanian deposits is in the Laman basin. When the facies are invariable, their thickness decreases in the north-western part of the region,on the northern slope of the ridge Selsela Koh-i-Band-i-Baba up to I50-I80 m,with the minimum thickness /60-100 m/ on the southern slope of the ridge Khwoja Abdal.

The formation of the described deposits took place in the marine basin with a stable shallow regime.

MAASTRICHTIAN STAGE Lower part/Cr_2mi/

The Maastrichtian deposits are developed in the Laman basin and outcrop out along the

the southern versant of the Khwoja Abdol.Scours,isolating the argillaceous-marlaceou lower part, considered in this section, from the upper part, overlying it,are obser ed among them.The argillaceous-marlaceous strata are composed of marls, clays and aleurolites.

Marls, greenish-gray and gray, compose nearly the whole sequence.Their main mass is micrograined, poorly micaceous, with quartz grains, muscovite flakes, thin-bedded and thin-platy.

Clays, light gray, highly calcareous,thin-bedded and thin-platy.

West of the pass Kotal-i-Sabzak brownish-gray marls of the Coniacian-Santon-Campanian stages up the sequences gradually change into greenish-gray, greenish-brown, aleuritic marls, 40 m thick,containing the following fossils: Gryphaea vesicularis Lam Gr.vesicularis Lam.var.similis Pusk.,Liostrea sp.,Chlamys ex gr.dujardini Roem.,Neithe cf.quinquecostata Orb, Cylcothyris aff.bangasii Orb. /fig. 6 ,25/.

Then ,after the tuffed band of Io m, red conglomerates and sandstones of the united Maastrichtian and Danian stages crop out.

The lower boundary of the Maastrichtian stage is drawn conventionally in the place ,where brownish-gray marls turn into greenish- gray ones.

Light gray calcareous, micaceous clays, changing into argillaceous-pyritic concre tions and Chlamys dujardini Roem. are seen along the western slope of the Laman basi in,I km north of the settlement Musami in the upper part of the Senonian strata of the marls /fig. 6 No.I6/.

Their thickness is less than 20330 m / the lower boundary is drawn conventionally

Sandy limestones and aleurolites also of the Maastrichtian stage overlie them wit with stratigraphical disconformity .

The similar phenomenon is observed along the eastern slope of the Laman Basin. Gre enish- gray, greenish-brown aleuritic marls with Gryphaea vesicularis Lam.,over 20 m thick, are seen in the upper part of the Senonian strata of the marls/fig.6 No. I8/.

The limestones and sandstones, described below,/see the Maastrichtian stage,lower part and Danian stage, united"/ overlie the first with erosion. The lower boundary of the Maastrichtian deposits is also drawn conventionally.

The found fossils and also the position in the upper part of the continuous se- quence of the Senonian deposits are indicative of the Maastrichtian age of the descrit ed deposits.

The Thickness of the Maastrichtian deposits in the Laman basin is,probably, not less than 30-50 m/ the lower boundary is drawn conventionally/. West of it the thickne ness decreases due to shearing of the Maastrichtian and Danian united strata of older formations. Thus, I0 km west of the Pass Kotal-i-Sabzak , along the right side of the Tagab-i-Mohammad Khan the Senonian marls/ about 80 m thick/ crop out in under the red strata . In the upper part of them Gryphaea vesicularis Lam.,Exogyre decussata Goldf, Discoscaphites/?/sp./the Campanian- Maastrichtian forms/ were found.

ness is only some metres. The similar picture is observed north-wesr, 2 km east of the settlement Darrah-i-Jowal, where Gryphaea cf. vesicularis Lam., Chlamys sp., Spondylus sp. were found directly under the red strata in the upper part of the Cenonian strata.

The accumulation of the described formations took place under the conditions of the marine basin existence with a shallow regime during the previous ages. Then a short-term land elevation took place in the middle and in the end of the Maastrichtian age, probably, the first one was changed by a new inrush. The land elevation was connected ,in all probability, with inconsiderable tectonic dislocations and was fixed by the occurrence of the red strata erosion on the lower part of the Maastrichtian deposits and with unconformity on older ones.

The Maastrichtian stage, upper part, and Danian stage, united /Cr_2m_s + d/.

The Maastrichtian and Danian non-divided deposits are seen in all the places of the Cretaceous deposits development.

The band with the Maastrichtian fossils is observed everywhere in their basement. As this band together with the barren red strata, conformably overlying the latter, lies with erosion and unconformity on the Maastrichtian and older deposits, we call them as Maastrichtian and Danian non-divided deposits.

The basic band is composed of sandstones, aleurolites, limestones.

The sandstones are light brownish-gray, yellow, yellow-gray. They are fine- or medium-grained, oligomictic/ quartzy/ with argillaceous-calcitic cement, medium-bedded

The aleurolites are brownish-yellow or light gray, fine- and short-grained, also essentially quartzy, calcareous, thin-bedded.

The limestones are light brown or light gray, usually aleuritic-sandy, massive o bedded, sometimes-compact and very hard. Dolomitic limestones are observed in the micr and fine-grained calcitic mass of which small dolomitic rhombohedrons/0.05-0.07 mm/ are up to 30-40%. The above mentioned mass is poorly argillaceous. Quartzy aleuritic grains are seen in an inconsiderable quantity.

The overlying red terrigene /locally-gypsum-bearing/ strata are made up of either conglomerates, gritstones, sandstones and aleurolites, or clays, gypsum and sandston

The conglomerates are brownish-cherry, fine-and medium-pebbled, bedded. The peb is middling or well round, well sorted, There are dark red, lilac-gray, more seldom-light gray sandstones, fine- and medium-grained, sometimes-they are quartzy- like, t then-aleurolites, locally-pink-white limestones, medium-grained and organogenic-frag ntal. The cement is sandy-calcitic-argillaceous, irregularly grained. The conglomerat make up separate bands, up to 10-15 m thick, or interbeds among gritstones and sand-stones.

The gritstones ,sandstones, aleurolites are brownish-cherry, dark-red or pink-yellow. Usually the rocks are inequigranular, essentially quartzy/besides quartz fra ments of aleurolites and argillites/,micaceous, bedded.

The clays are dark claret-red, red -brown, more seldom- gray, greenish-gray. They are aleuritic-sandy, often-dolomitic, lumpy.

The gypsum is white, grayish-white. It forms nodules in the clays, either-lens-like interbeds, up to I m thick, with thin interbedding of gypsum and clays.

Somewhat different sequences of the described deposits are observed in the region o the pass Babzak, in the northern part of the Laman basin and on north-west of the region /fig.5/.

West of the pass Babzak a turfed area /about I0 m/ is over the Maastrichtian marls on the south-eastern slope of the ridge Khwoja Abdal. /Fig 17-25/

I/ Claret-cherry fine-pebbly conglomerates . . . I5.0 m

2/ Interbedding of dark brownish-, claret-cherry conglomerates and sandstones. . . 90.0

3/ Interbedding of claret-cherry gritstones and dark red, pink -yellow sandstones . .40.0

4/ appear above them.

Paleocene deposits overlie them concordantly. The thickness of the considered deposits is about I45 m.

I. Dolomitic yellow-gray limestones ....0.7 m

2. Light brownish-yellow calcareous ale rites . . .I2.0 m

3. Light gray limy aleurites . . . 3.0 m

4, Interbedding of claret-red/more seldom of greenish-gray /clays, gypsed in the m... middle and upper parts of the section . . .I20.0 m lie on the Maastrichtian deposits with discordance stratigraphic on the uneven, slightly hillocky surface, I km north of the settlement Muzami along the western slope of the Laman basin. /see "the Maastrichtian stage"/.

The total thickness of the non-divided Maastrichtian and Danian deposits is about I36 m in the given sequence /Fig.5/

The similar character of the sequence can be observed along the eastern slope of the Laman basin.

I/ Brownish, lumpy, hard limestones . . .0.9 m

2/ Light-yellow fine-grained sandstones . . .2.0 m

3/ Light-, lilac-gray fine-grained sandstones . . .I3.0 m

4/ Interbedding of dark -cherry, brownish-cherry sandstones and red-brown sandy clays which are gray-green in the upper part, with marl interbeds. lie on the Maastrichtian marls along the uneven surface of the erosion.

The thickness of the Maastrichtian and Danian deposits is about 125.9 m here. The Paleocene deposits overlie them concordantly.

North of the described sequence gyps appears in a sequence, 2 km east of the settlement Laman

I/ vesicular limestones . . .7.0 m

2/ Brownish-red sandstones, gypsed in the middle and upper parts . . .40.0 m

3/ Bluish-gray limy-dolomitic clays with interbeds in the upper part of the gypsum...I0m overlie the Cenonian marls with erosion.

The Paleocene deposits overlie them concordantly . The thickness of the Maastrichti an and Danian deposits is 57.0 m in the sequence.

We found fossils in the base/of the considered strata in a series of places. A bed ment of sandy limestone/I0 m/ with Chlamys dujardini Roem., Gryphaea Aff. pitcheri Mort. crop

out under the red strata ,2 km north-northwest of the settlement Darzak.The bed overlies the greenish-gray Cenonian marls with erosion. Interbedding light yellowish-gray, light gray aleurites and fine-grained sandstones crop out with Chlamys dujardini Roem. ,with the visual thickness -15 m,under the red strata of sandstones and gritstones /alterating sharply,but without visual discordance/ ,2 km south-east of the settlement Sapedar.

The Maastrichtian and Danian deposits are present in the north-western part of the region as well. However, Their separation was made conventionally to an inconsiderable degree,due to the absence of fossil finds and the section monotony.The Maastrichtian and Danian deposits,overlying either the Upper Triassic or Turonian deposits discordantly, reach a thickness of 80-100 m and are represented by interbedding /bands up to 15-30 m/ of yellow-brown,cherry-red sandstones and aleurites. Ferruginous imprints of poorly preserved plants are observed in yellow-brown sandstones. Probably, a band of sandstones,similar by their outward appearance to the ones, attributed by us, to Paleocene, overlies them concordantly./Fig.5/.

The red strata is barren. That is why the Maastrichtian-Danian age of the described deposits is accepted by us due to the presence of the above mentioned Maastrichtian fossils in their basic band and due to concordant occurrence of the Paleocene deposits on them. The comparison of the described deposits with the Danian deposits of Northern Afghanistan and Tadjikistan allows to draw the same conclusion.The Basic band belongs to the Maastrichtian stage,undoubtedly.,but the position of its upper boundary is not clear.

In 1962 Ivanoff S.D. ,etc. attributed only the marlaceous band to the Maastrichtian stage /10m thick at the settlement Khyoja-Sahab/ and also attributed the bottoms of the red strata. In 1961 Chepoff Ju.P. ,etc attributed only the carbonate-sandstone band/about 10 m thick/ in the base of the red strata. Unlike the former investigators we ascertained its binomial structure/Fig.4/. The lower marlaceous part is divided from the upper one by a stratigrapfical break and erosion/probably, as a result of poorly shown dislocations.

The non-divided Maastrichtian and Danian deposits reach the maximum thickness /about 145 m/ in the southern part of the Laman basin, reducing down to 57-100 m in the northeastern part of the region and down to 60-80 m west of the pass Sabzak. The thicknesses increase somewhat in the north-west of the region,but they do not exceed 100 m.

The accumulation of the described deposits took place in the conditions of the marine basin,which occupied again the northern part of the studied territory after the short-term elevation in the middle-end of the Maastrichtian age. During the Danian age the sea had no tendency to widen. On the contrary, it become shallow, fell out into separate lagoons,

. The red colour of the fragmental deposits and gypsum presence in the middle and upper parts of the sections of the northern part of the Laman basin are indicative of it. The sou-

thern part of the territory was land.The northern boundary of the land passed,probably, in a sublatitudinal direction immediately south of the pass Babzak. In fact, sandstones with thick interbeds of conglomerates/ with the pebble of the Permian red rocks and Albian limestones /prevail at the pass,while 10-15 km north of the pass the section is composed of gypsed clays with gypsum interbeds and subordinate sandstones. Gritstones are very rare and conglomerates are quite absent.

The marine basin in the north-western part of the territory had somewhat different regime. Being also shallow, it suffered only inconsiderable level oscillations. There are neither coarse-fragmental deposits , nor gypsum. Probably, the land,situated to the south,was more peneplanatized to the Danian age,than in the east,or the shore line retreated here to the south.

PALEOGENE SYSTEM. /Pg/

The Paleogene system, as well as the Cretaceous one, is developed only in the northern part of the studied territory at an area of about 1100 km² and is represented by Paleocene and Eocene. The Susak,Alaian and Turkestanian stages are distinguished in the latter//fig.6/. The Paleogene deposits compose the tops of the ridge Selsela Koh-i-Band-i-Baba and Khwoja-Abdal, the basin of the Darya-i-Qala Caghar and the district of the left tributaries of the Kusk.

The Paleogene deposits overlie the Cretaceous ones concordantly and occur usually rather gently,only in places they form box folds and acquire steeper bed dips near fractures. The Neogene deposits overlie them with erosion.

PALEOCENE. /Pg,/

The Paleocene deposits make up narrow bands of outcrops in precipitous slopes of the highest areas of the region, sometimes they armoured the surfaces of cuestas.

They are represented by carbonate / northeast of the region/ or terrigene/northwest/ strata,composed correspondingly by limestones,marls, clays,aleurites or sandstones and aleurites.

The limestones are brownish-gray,greenish-yellow,sometimes-spotted cherry-brown. Sometimes aphanitic diffreneces/with micrograined subsilicic mass of slightly pelitized calcite dense,hard,medium- and thin-bedded,also seldom-gypsed,argillaceous and bedded ,and platy are distinguished among them.All of them contain negligible admixture of quartz aleuritic grains.

The marls are grayish-,greenish-brown,seldom-spotted lilac-brown, are made up of micrograined argillaceous-calcitic mass with frequent small pores /up to 0.05 mm/.The calcite grains are pelitised. Sometimes the marls contain a negligible admixture of aleuritic grains of quarts. The rocks are dense,hard,sometimes they are cloddy,bedded,platy.

The clays are green-gray,gray,they form separate thin interbeds, They are calcareous,

sometimes-aleuritic, tabular, or cloddy.

The aleurites-greenish-brown, gray, yellow-brown. The rocks are calcareous, micaceous. They are made up of quartz grains, mainly; muscovite flakes, argillite fragments are seen more seldom. The argillaceous-calcitic cement amounts to 20-30%. The structure is disorderly. The rocks are thin-bedded, platy.

The sandstones are yellow-brown, brownish-gray. They are fine-grained /seldom-medium-grained/ rocks with a small quantity of grains, measuring up to 0.3 mm, and aleuritic gragrains. The sandstones are oligomictic, quartzy. Fragments of argillites, aleurites, acid effusive rocks, muscovite flakes are observed besides the quartz. The structure is disorderly. The cement /containing up to 30% of the rock sometimes/ is argillaceous-calcitic, basic or clotty /interstitional or of pores/, irregularly grained, or muscovito-ferruginous-argillaceous, contact cement or corrosive. Sometimes lenses of quartz gritstones are observed among the sandstones.

The following sequence of Paleocene is seen along the eastern slope of the Laman basin.

I/ Gray, light brownish-gray marls . . . . . 8.0 m

2/ Lilac-green calcareous clays . . . . . 2.0 m

3/ Grayish-brown aleuritic marls over 80.0 m

overlie the greenish-gray clays of the Maastrichtian and Danian stages in the cuesta scarp concordantly.

The Suzak formations overlie them concordantly. The thickness of the Paleocene deposits in the given sequence is 90 m.

The similar sequences of Paleocene, composed of marls of limestones, are observed in the northern part of the Laman basin, reaching 60-90 m.

The following sequence is observed on the western slope of Yakhak, along the south-eastern framing of the Laman basin.

I/ Cherry-brown aleuritic limestones . . . . . I.0 m

2/ Greenish-brown, brownish-gray limestones . . . . . 8.0 m

3/ Greenish-brown, gray marls . . . . . I5.0 m

4/ Greenish-gray, brown aleurites . . . . . 8.0 m

5/ Yellow-brown calcareous aleurites . . . . . .8.0 m

6/ Brownish- and yellow-brown, calcareous aleurites . . .I5.0 m

overlie the red Maastrichtian-Danian strata withoutapparent discordance.

The deposits of the Suzak stage overlie them concordantly. The total thickness of the Paleocene deposits is 55 m.

The band /I5-20 m thick/ of yellow-brown, brownish-gray sandstones, fine- and medium-grained, with interbeds of quartz gritstones /up to o.5 m/, overlying the Maastrichtian and Danian deposits concordantly and overlain by the Suzak deposits, is attributed conventionally by us to Paleocene /in the North-West of the region/.

South of the settlement Khwoja-Sahab Paleocene is represented Chepoff Ju. P., etc, 196 by gray, yellow-gray sandstones, fine-grained, with interbeds of sandy limestone in the base ment /2 m/ and of quartz gritstone in the roof, with the total thickness of 30 m. The fossils: Cardita sp., cardiopsis sp.

We feund Lucina aff. microdonta Desh. in the middle part of the carbonate section of Paleocene. The described deposits are attributed by us to Paleocene on the ground of the position in a continuous sequence /over the Maastrichtian and Danian stages under the Suzak one/.

Paleocene reaches the maximumthickness in the northern part of the Laman basin, The thickness reduces down to 55 m and even less west of the pass Sabzak in its southern port; down to 40-60 m along the southern slope of the ridge Khwoja-Abdel and down to 15-30 m along the slopes of the ridge Selsela Koh-i-Band-i-Baba. Simulatneously with the reduction of Paleocene thickness from north to south and from the change of the sequence character takes place: carbonate facies turn into terrigene ones.

The accumulation of the Paleocene deposits took place in the shallow marine basin, south of which /probably, in the southern part of the studied territory/ the peneplenized land was situated.

EOCENE.

LOWER EOCENE.

SUZAK STAGE /Pq^{I}_{2} SS/

The Suzak deposits compose a vast field in the region of the ridge Khwoja-Abdal and north of it, on a flat waterahed space between the Laman basin and the Darya-i-Gala Caghar. They overlie the Paleocene cuestas or form narrow bend of outcrops in the precipitous slopes of the ridge Selsela Koh-i-Band-i-Baba.

The Suzak stage is represented by argillaceous-terrigene strata, made up of sandstones, aleurites, clays, marls.

The sandstones are fine-grained or medium-grained, pudding in lenses /with separate gravel grains/ and aleorites, coarse-grained, both of them are brownish-gray, pink,lilac-gray, yellowish-brown, seldom-dark-cherry. The rocks are oligomictic /essentilly quartzy/, calcareous, argillaceous, micaceous, sometimes-slightly gyped, fire- and medium-bedded, seldom-massive. In places the sandstones are cemented very slightly and turn into loose fine-grained sands. The sandstones are observed as separate interbeds and form a thick/ up to 50 m/ Kusk horizon, separating the less lower part of the sequence from the larger one.

The clays are greenish-gray, calcareous, aleuritic, non-clearly-bedded, sometimes= schistose, thin platy, compose the main part of the sequence alongside with the alcurites.

The marls are brownish-, bluish-gray. They are seen only as separate interbeds. They are often argillaceous, aleuritic.

The following sequence of the Suzak deposits is observed along the south-eastern

1/ Yellow-brown, calcareous , argillaceous aleurolites . . . about 50.0 m

2/ Lilac-, brownish-grey, fine-grained sandstones , lenses of pudding sandstones . . . about 50.0 m

3/ Greenish-grey brown, grey clays with interbeds of greenish-brown aleurolites, prevailing in the basement . . . about150 m.

overlie Paleocene concordantly.

The total thickness of the deposits in the above section reaches 250 m.

The folowing sequence is observed south of the settlemnt Khwoja-Sahab/ Chepov Ju. P/ etc. 1961/, Fig6, sec.22.Paleocene is concordantly overlain by:

1/ Claret-red aleurolites . . . 10 m

2/ Light-grey fine-grained sandstones . . . 5.0 m.

3/ Claret-red aleurolites . . . 18 m

4/ Claret-red clays with interbeds of aleurolites and sandstones . . . 7.6 m.

5/ Grey, yellow-grey fine grained sandstones with gritstone lenses 10.5 m

6/ Greenish-grey sandy clays with Ostrea cf. hemiglobosa Rom., Natica sp., Pholadomua sp. . . . 105.0 m.,

concordantly underlying Alain formations.

The total thickness of the Suzak deposits in the given sequence is 156 m.

Ostrea / Solidostrea/ hemiglobosa Rom., Gryphaea cf. smirnovi Rom. were found by us in the considered deposits. Their presence and also the position in the sequence / concordant occurrence between the Paleocene and Alain stages/ are indicative of their lower Eocene, Suzak age.

The Suzak deposits reach a thickness of 240 -250 m on the Khwoja-Abdal ridge and along the southern framing of the Laman basin, reducing down to 156 m westward /the region of the settlement of Khwoja-ABDAL/ and even less in the marginal north-western part of the region, where their thickness does not exceed 60-80 m in the upper reaches of the Gurgo gorge.

The formation of the Suzak deposits took place in the shallow marine basin, which suffered only small oscillations of its level / it adjoined the peneplenized land from the north/

MIDDLE EOCENE /Pg^2_2/

ALAIAN STAGE /Pg^2_2/al/

The Alaian deposits armoured the highest cuestas along the south-eastern framing of the Laman basin, the ridge Selsela Koh-i-Band-i-Baba and Khwoja-Abdal.

The Alaian stage is represented by argillaceous-terrigenc strata, composed of conglomerates, sandstones, aleurites, clays and marls. Tuff interbeds are also seen in it.

The conglomerates-are brownish-red, fine-pebbled. The pebble is medium-rounded and sized. It is made up of black aphanitic, more seldom- sandstones, sometimes- it is wholly quartzy. The cement is sandy-argillaceous, irregularly grained. The conglomerates compose single thin interbeds in the upper part of the sequence.

The sandstones are yellowish-brown, light-gray, seldom-lilac-red. They are fine- und medium-grained, oligomictic/ essentially quaftzy/ or biotitic-feldspathic, calcareous, thinmedium- or thick-bedded, sometimes they are obliquely laminated. White quartzy gritstones with well-rounded and medium-sized grains are observed in seaperate lenses or interbeds /up to 0.8 m/ among the sandstones. The lower part of the sequence is nearly wholly made up of sandstones.

The aleurites are light-gray, brownish-gray, fine- and short-grained, calcareous, thinbedded or thin-platy. Sometimes they are highly calcareous, argillaceous, acquire yellow colour are filled with coquina. They form single interbeds in the lower and middle parts of the section. The aleurites in the upper of the sequince are argillaceous, micacoous,dark brown-red.

The clays are greenish-gray in the lower part of the sequence and rod-brown, lilac-violet, olive-green-gray in the upper part. They are leafy or cloddy, sometimes they are argillite-like /it the top of the sequence/, aleuritic.

The merls are gray, greenish-gray, usually aleuritic. They are observed as single interbeds.

The tuffs are dark-gray, dark green-gray, black, they compose the interbed, 10-30 m thick. they are lithowitherocrystallolastic tuffs of andesites and andesito-basalts with psephito-psammitic texture. They consist of anguler flagments of the minerals /plagioclase, augite, horn blende, mose seldom-quartz, the ore mineral/, of voicanic

glass and fragments of andesites, basalts, hyalobasalts, more seldom of dacites. The cement is ashy, carbonateous or mixed. The tuff interbed is observed only in the upper part of the sequence, among red aleurites.

The following sequence of the Alaian deposits is seen on the northern slope of Koh-i-Pirhakka. /Fig. 6, section No. 2I/ Probably, the greenish-grey aleurolites and clays of the Suzak stage are overlain concordantly by:

I_2/ Drownish-gray sandstones with lenses of quartzy gritstones . . . . . 40.0 m

2/ Interbedding of greenish-brown clays and aleurites . . . . . 30.0 m

3/ Yellowish-brown, brownish-gray sandstones . . . . . 40.0 m

4/ Brownish-red, lilac-, greenish- gray clays with interbeds of cherry sandstones and aleurites . . . . . 80.0 m

5/ Greenish-gray botitic-feldspathic sandstones . . . . . 20.0 m

6/Lilac-violet, olive-green-gray clays . . . . . 30.0 m

7/ Light limestones-coquina . . . . . I.0 m They are overlain by talus loams, lie conformably on the [illegible] clays of the Suzak stage. The total /visual/ thickness of the Alaian deposits is 24I m here.

The section, similar to the one, described above, is observed north of the above mentioned, along the right bank of the Darya-Gala-Cagar. On argillaceous-aleuritic band and are conformably bedding:

I/ Brownish-, yellowish-gray sandstones . . . 25.0 m

2/ Greenish-gray clays with aleurite interbeds . . 25.0 m

3/ Brownish-gray sandstones with gritstone lences . 70.0 m

4/ Brown-red aleurites with sandstone interbeds . . 30.0 m

5/ Yellowish-gray limostones . . . . . 2.0 m

6/ Greenish-gray aleurites with interbeds of the marls and limostones with Ostrea multicostata Desh., Ostrea turkestanensis Rom. var. baisunensis ohm . . . 50.0 m They overlie concordantly the argillaceous-aleuritic band of the Suzak stage.

The thickness of the Alaian deposits in the Given section is 202 m. The volcanogenic strata of the Turkestan stage overlie them with erosion.

The following section of the Alaian deposits, changing concordantly the Suzak ones, is observed in the north-western part of the region, along the southern slope of Koh-i-Takht-i-Khanum.

I/ Interbedding of greenish-gray calcareous and aleurito-sandy marls . . . . . 40.0 m

2/ Yellowish-gray, light gray sandstones with lenses of quartzy gritstones and conglomerates . . . . . 25.0 m

3/ Interbedding of dark red sandstones and aleurites . . . . . 23.0 m

4/ Light gray quartzy sandstones . . . . . 25.0 m

5/ Claret-red aleurites . . . . . 20.0 m

6/ Light gray fine-grained sandstones . . . . . 4.0 m

7/ Claret-red aleurites and clays with interbeds of sandstones . . . . . 40.0 m

8/ Light gray quartzy conglomerates . . . . . 5.0 m

9/ Claret-red alearites with sandstone interbeds . . . . . 80.0 m

IO/ Tuffs, sandstones, black, gray-black tuffogenic . . . . . I8.0 m

II/ Interbedding of claret-red aleuritic clays, aleurites and sandstones . . . visual thickness 45.0 m

The Permian formations are overthrust on bed II along the steep tectonic contact. The total /visual/ thickness of the described deposits reaches 325 m.

The found fossils and the position of the described formations in the section /are overlain by the turkestanian stage concordantly with erosion and lie concordantly on the Suzak ones/ give the possibility to attribute them to the Alaian stage of the middle Eocene.

The Alaian deposits, composing the highest of the region, are highly washed out That is why it is very difficult to say something of their thicknesses change along the area. We can suppose only that the thickness exceeded 200-300 m everywhere.

The Alian deposits began to be accumulated in the conditions of the shallow marine basin, adjoining the peneplenized land. Probably, the total territory elevation and shallowing of the marine basin with its falling into separate areas, took place. The appearancence of coarse-fragmental deposits in the tops of the section as of oyster banks and red colour of the terrigene rocks are indicative of that. At the some time, after a long period of still condition, the first indications of volcanic activity showed, which is confirmed by the presence of the tuff interbed in the upper part of the section.

UPPER EOCENE. TURKESTANIAN STAGE /Pg_2^3 tr/.

The deposits of the Turkestanain stage are spread in the western part of the inves tigated territory. They crop out in the Darya-i- Gala Chaghar basin on the ridge Koh-i-Band-i-Baba and in the regions, situated south and south-west of the settlement Karukh. By lithological features these deposits are dismembered into two suites:lower-"tagaurabat"/ terrgene/ and upper "galachar"/ volcanogenic/.

TAGAURABAT SUITE/ Pg_2^3 2 tg/.

The deposits of the Tagaurabat suite crop out at an area of about 800 km^2.The most spatial outcrops of this suite are in the Tagab-i Mohammed Khan, on the western extremity of the ridge Selsela Koh-i-Band-i-Baba in its near-watershed part and in the region located south and south-west of the settlement Karukh.

The rocks of the Tagaurabat suite overlie the underlying Alaian or Suzak deposits with non-evident stratigraphic discontormity , and they overlie alder deposits / Triassic, Maastrictian-Danian/ with angular / up to 45°/ and azimuthal / up to 60°/ unconformity,The rocks of the Tagaurabat suite are also overlain by volcanogenic formations of the Galachar suite unconformably,angular and azimuthal unconformities /about 16° and 15° correspondingly/being noticeable in bedding locally, which is indicative of tectonic movements and the following erosion in pre-Galachagar time. This erosion conditions the complete omission of the deposits of the Tagaurabat suite / over 700 m/ from the sequence, sometimes observed .

In the north-western part of the region the rocks of the Tagaurabat suite are dislocated conformably with the deposits of the Alaian and Suzak stages. The dip angles of the beds do not exceed 10-15°. Intensive crumpling of the deposits is observed only near the fractures. In the south-west of the region the rocks are crumpled into minor folds with dip angles on the wings of 15-25° or more steep near the fractures.

Strong facies changeability, extreme non-persistence of some horizons are typical of the deposits of the Tagaurabat suite.Red conglomerates, sandstones, clays, gritstones aleurolites are prevailing rocks.

Conglomerates dark-brown, almost black, from a distance they are red-brown, coarse-bedded, gravelly-pebbly, with inclusions of some boulders and interbeds of medium-bouldered conglomerates. The coarse gravel is not sorted, of medium- or good roundness, more seldom-unrounded, measuring up to 10-20 cm and more. It consists effusions, gneisses, quartzy-micaceous schists, sandstones, limestones, granites, veined and tufogenic rocks, quartz, etc.The cement is red-brown, sandy-argillaceous with admixture of tufogenic material.

Sandstones , lilac-gray, ashy-gray, red-brown, more seldom-greenish-gray, co

compact, thin-platy, often-oblique-bedded, inequigranular, micaceous. By the fragments composition the sandstones are divided into oligomikt quartz-feldspathic, polymikt-and sandstones with admixture of tufogenic ma terial. The rocks consist of rounded, more seldom-angular grains of quartz feld spar, siliceous and effusive rocks. Usually scales of chloritized mu covite and separate grains of accessory minerals -zircon, ore minerals, epi dote, tourmaline are an inconsiderable admixture. The cement is porous or b basal, calcitic with admixture of argillaceous material.

Gritstones are coloured into the same hues as the sandstones. Frag ments of siliceous and effusive rocks/andesites, dacites, etc./ prevail over grains of quartz, feld spar and fragments of quartzites in them. The cementing material consists of smaller fragments of the same rocks as calcite. Purely quartzy gritstones are seen very seldom.

Clays, red-brown, brownish, sometimes-green, cloddy, shelly, fragmental, sometimes-thin-platy, of medium compactness, usually with separate sandsto stones and gritstone grains.

Aleurolites red-brown, brownish-gray, more seldom-yellowish-gray, and greenish-gray, thin-schistose, micaceous, slightly calcareous.

In the regions, located south and south-west of the settlement Karukh the described rocks are in constant alternation. The most spread rocks among them are conglomerates, forming bands, 30-50 m thick. Locally the conglomerates with inconsiderable erosion overlie the underlying deposits. Sandstones and gritstones either form independant bands, 10-15 m thick, or are observed as thin interbeds-lenses among the conglome rates. Clays and aleurolites are spread not so widely. The thickness of the interbeds of these rocks does not usually exceed 5-8 m.

In the lower course of the Rod-i-Karukh river, near the western boundary of the investigated region the deposits of the Tagaurabat suite include sills and lens-like elongated intrusive deposits of basalts, basalt porphyrites or / much more seldom / andesi tic porphyrites. The rocks lie almost-conformably with the containing deposits. Apophysis cuts them. Near the contact the containing deposits are crumpled. The maximum extent of the bodies is 1600 m. The cross-section of some of them is 150-180 m.

Basalts and basaltic porphyrites -porphyric, sometimes-amygdaloidal rocks, dark- gray, black, dark-green. There is columnar jointing. Impregnations in them are represented by well faced tabular crystalls of labrador No.60-65/ plagioclase porphyric basalts prevail/, more seldom- by small separations of olivine or augite. Sometimes porphyric separations form glomeroporphyric growths. Plagioclase impregnations can be replaced by sericite and carbonate, augite-essentially -carbonate. Sometimes bowlingite or carbonate develop out of olivine. The main mass consists of microlites of plagioclase / also labradorite/, small prisms and grains of augite sometimes-glass and dotted separations of the ore mineral. The main mass is intersertal, pilotaxitic, more seldom-micrograined. The amygdules are of angular outlines and often of zonal structure: the outward fringe is com-

posed of carbonate and the core - of zeolite. The largest amygdules have 2-3 cm in diametre. A chalcedonycryptograined aggregate and carbonate are seen in veinlets.

Andesitic porphyrites-porphyric rocks, dark gray with violet hue. The impregnations in them are represented by acidic andesite and dark minerals, wholly replaced with carbonate. The main mass is not transparent, consists of volcanogenic glass and small amygd[illegible]ules , filled with zeolites. The main mass is hyalopilitic.

We have no data of the age of the intrusive deposits of basalts and andesitic porphyrites. It is clear that they are younger than the red rocks, containing them, as they cut them. One can only suppose that they are simultaneous to volcanogenic formations of the Galachagar suite ,and in this case " root" parts of lava flows can be considered.

The thickness of the described deposits is about 900-1000 m.

The following sequence of red formations of the Tagaurabat suite was described on the left side of the Tagab-i-Mohammad Khan river at the settlement Tagau Rabat. On the deposits of the Alaian stage lie without evident disconformity:

1.	Clays, redObrown, with interbeds of conglomerates and sandtsones	50-100 m
2.	Interbedding of conglomerates and clays	20-50 m
3.	Clays with subordinate interbeds of conglomerates and sandstones	No.100m
4.	Conglomerates, bouldered-pebbly with interbeds of red-brown clays	15 m
5.	Red-brown clays	125 m
6.	Conglomerates, bouldered-pebbly	320 m

The total thickness of the rocks is 630-710 m.

Effusions and tuffs of the Galachagar suite lie over without evident angular unconformity.

In the Darya-i-Gala Chagar and in the ridge Selsela-Koh-i-Band-i-Baba interbedding red sandstones, conglomerates, clays are prevailing rocks in the lower part of the sequence.Due to facies changeability of the deposits, in some cases prevailing of compact aleuritic clays over sandstones and conglomerates / as in the sequence near the settlement Tagau Rabat/ is observed, in others - sandstones and gravelly-pebbly conglomerates acquire the most meaning, and clays are almost absent.The upper part of the sequence is composed of coarse-pebbly conglomerates mainly. Interbeds of medium-bouldered conglomerates, much more seldom-sandstones and clays , are seen among these rocks. The thickness of the deposits does not usually exceed 700-800 m.

This is the lithological characteristic of the deposits of the Tagaurabat suite. The basis of their age will be considered below together with volcanogenic formations of the Galachagar suite.

Accumulation of the deposits of the Tagaurabat suite took place in the coastal part of the basin. A considerable mass in volume of sediments accumulated, probably, in the conditions of spatial deltas, which is confirmed by facial unstability of deposits and oblique bedding , observed in the sandstones. Thick horizons of conglomerates among the deposits of the Tagaurabat suite points to the presence of considerable uplifts in the district of removal. Intensity of these uplifts and troughs, compensating the first, increased in due course. The sea receded at the end of the sedimatation cycle after the accumulation of strata of coarse conglomerates.

The thickness of the Tagaurabat suite remains comparatively constant on the whole territory. In the regions , located south and south-west of the settlement Karukh the deposits thickness / apparent/ reaches 900-1000 m; the thickness of the deposits increases west and north of Tagau Rabat up to 800 m.

Sharp decrease of thickness down to 50-60 m, sometimes observed ,for example, in the lower course of the Darya-i-Hoja Shahab or complete omission of rocks from the sequence /in the upper course of the Darya-i-Gala/ are connected with the erosion of the deposits in the period, preceding the volcanogenic formations of the Galachagar suite.

GALACHAGAR SUITE / Pg_2^3 gl/.

The rocks of the Galachagar suite crop out approximately at the same area as the deposits of the Tagaurabat suite. The most spatial areas, composed of these rocks, are located in the Darya-i-Gala Chagar basin and in the near-watershed part of the ridge Selsela Koh-i-Band-i-Baba east of the ridge Kotal-i-Ustur Murda.

The considered deposits overlie the rocks of the Tagaurabat suite with evident angular ,and sometimes azimuthal unconformity. More seldom the contact has a concordant character. Locally superposition of the rocks of the Galachagar suite immediately on the deposits of the Alaian stage, characterized faunistically, is observed , as it was already mentioned.

The rocks lie gently, almost horizontally in many cases. Sometimes they are crumpled into minor folds with dip angles on the wings 5-10°, more seldom-20-25°.

Volcanogenic formations , among which effusive rocks prevail, are abundant in the composition of the rocks of the Galachagar suite.

In the Darya-i-Gala Chagar / fig.2I/ basin the strata of the rocks of the Galachagar suite have a bi-nomial structure.

Its lower part is composed of hornblende andesites, or tuffs of andesites,changing them,along the strike.Interbeds of tuffs of acidic effusions and dacites are observed in the upper course of the Darya-i-Gala Chagar.among these rocks.

The strata thickness does not remain constant and changes within the limits of 10-20m and 100-120 m.

The sequence is built with additional thick strata of agglomeratic lavas and lava -breccia of basalts and basaltic porphyrites, among which "pure" lavas occupy a subordinate position. They are very widely spread in the Darya-i-Gala Chagar basin. The thickness of the streams of these rocks reaches 30-40 m. Some horizons differ in colour, composition, quantity and dimensions of fragments, forming them. Sometimes Interbeds of sandstones are seen in the strata. Their thickness reaches 8-10 m.

The maximum apparent thickness of the strata is 150 m.

The total apparent thickness of effusions and tuffs of the Galachagar suite is 250-270 m in the Darya-i-Gala Chagar basin.

The description of the rocks, composing the Galachagar suite in the Darya-i-Gala-Chagar is given below:

Hornblende andesites greenish-gray rocks with discernible porphyric separations, amounting to 30% of the total mass, represented by crystals of hornblende and zonal plagioclase, probably, andesine. The main mass consists of disorderly located microlites of plagioclase and glass / microlitic structure/. Carbonate fills separate small voids in the rock and develops out of hornblende.

Tuffs of andesites, violet-gray, lilac-gray or greenish-gray with crystalline-lithoclastic psammitic structure. Fragments of andesites / 0.5-1mm and plagioclase crystals prevail in them. Fragments of quartz crystals are seldom seen.

Tuffs of acidic effusions, crimson-gray, green-gray, with lithocrystalloclastic psammitic structure. They consist of fragments of crystals of quartz/ prevail/ and feld spar. Besides, fragments of the main mass of quartzy albitophyres, hypidiomorphic or prismatically-grained in texture, and also single fragments of sedimentary rocks-fine-grained limestones and quartzy-muscovitic schists are distinguishable.

Dacites, dark-gray with porphyric separations of the dark mineral, fully replaced by calcite. The main mass is prismatic-grained / trachytoid/

Basalts and basaltic porphyres -very compact, black-green, greenish-gray rocks with porphyric texture. Augitophyric and plagiophyric differences differ in prevailing of augite or basic plagioclase/usually labradorite No.68-70/. Olivine is seen in impregnations more seldom. Augite impregnations reach 5-8 mm in diametre. Sometimes the augite is replaced with carbonate and chlorite. Locally the replacement of the basic plagioclase with augite is observed. Laths of plagioclase, augite grains, those of magnetite, carbonate and cementing recrystallized glass/volcanic/ are observed in the main mass. The main mass is intersertal, pylotaxic, more more seldom-hyalopilitic.

Agglomeratic lavas and lava-breccias of basalts and basaltic porphyres CONSIST OF basalts /basaltic porphyrites/, measuring 1-10cm; more seldom fragments, reaching 1-1.5 m in diametre, are observed. Large fragments have flattened angles, sometimes quite rounded. The cementing lava is of the same petrographic composition as th e fragments, included into it/

_Sandstones ,violet, fine-grained,feldspathic in composition, with filmy argillaceous-micaceous cement.

o.5 km south of the pass Kotal-i-Ustur Murda coarse-rubbly conglomerates of the T Tagaurabat suite are broken with a dike of greenish-gray andesites, up to 3 m thick. The andesites took many coarse gravels and boulders from the containing rocks, especial lly in its marginal part. At the top the dike turns into a thick body and then into a cover, composed mainly of gray-green augitic andesitic porphyrites, with which the sequence of deposits of the Galachagar suite begins.Thus, Lava outflow took place in t the given area along the fracture.

The rocks, observed south of the pass Kotal-i-Ustur Murda, have the following characteristic.

Andesites- porphyric rocks, microlitic, locally pilotaxitic in their main mass. Impregnations, amounting to not more than I0% of the total mass are formed with sericitized plagioclase and dark mineral, replaced by chl chlorite. The main mass represents a thin "felt" of microlites of plagioc clase, including small grains of ore mineral.

In augitic andesitic porphyres phenocrystals are composed of slight ly greenish diopsidic augite and zonal plagioclase. The main microlitic mass is highly obstructed with small grains of the ore mineral.

A very peculiar sequence of the Galachagar suite is observed immediately at the pass Kotal-i-Ustur Murda / fig.2I/.

Here coarse-rubbly conglomerates of the Tagaurabat suite are sharply ,but confor mably changed by gray to black conglomerates, among which interbeds of gray tufogenic sandstones, greenish-gray argillites, black-green augitophyric hyalobasalts, greenish-gray tuffs of plagioclase andesites, 2-5 m thick, are observed among them.In the upper part of the sequence agglomeratic lavas of basalts, in some places broken by dikes and small stock-like isometric bodies, r /5-I0 to 20 m in diametr of basaltic porphyrites, are prevailing.

The apparent thickness of the strata is not less than I00m.

0.3 km east of the pass Kotal-i-Ustur Murda the described rocks are broken by light gray trachytes / albitophyres/, cropping out as stocks ,rounded in form/funnel facies/ in some places. Up the slope these rocks give a cover and overlie the agglome ratic lavas of basalts, above mentioned, with evident disconformity.

The apparent thickness of the outcrops of trachytes/ albitophyres/-50-60 m.

The summary apparent thickness of the rocks near the pass Kotal-i-Ustur MUrda is I50-I70 m.

The rocks, developed east of the pass Kotal-i-Ustur Murda, are described below:

_Conglomerates-*COARSE*PEBBLY TO FINE* rubbly, consisting of pebbles of effusions,sandstones, red Permian rocks, cemented with sandy-aleuroli tic material of sedimentary and tufogenic origin.

In augitophyric hyalobasalts the main mass, hypocrystalline, consists of basic volcanic glass with a great amount of inclusions of the ore mineral. Small impregnations of plagioclase are of isometric outlines and zonal textur Idiomorphis separations of augite, out of which chlorite and carbonate develo are the largest / up to 3-4 mm/.

Tuffs of plagioclase andesites are lithocrystalloclastic, psephitopsamm ic. Pyroclastic material consists of fragments of plagioclase crystals and mor seldom-augite, and also of fragments of volcanic glass and andesites. The rock fragments have indistinct boundaries with the cementing mass / sintered tuff

Trachytes/albitophyres/ -porphyric rocks with pilotaxitic texture of the main mass. The impregnations are represented by albite-acidic oligoclase /10%/ and more seldom- biotite /2%/. The minerals of the impregnations have idiomorphic outlines. The basis, prevailing over the impregnations, consists of small laths of acidic plagioclase and rare xenomorphic grains of quartz /about 3%/.

2 km south-east of the pass Kotal-i-Ustur Murda the strata of effusions overlie the underlying coarse-rubbly conglomerates with inconsiderable angular unconformity.

Dark green basalts and hyalobasalts with large / 3-4 mm. more seldom-upto 1cm/ augite impregnations begin the strata sequence here /fig.21/.

The rocks thickness is about 60 m.

Over, the strata of agglomeratic lavas and lava-breccias, in which the thickness of some interbeds is 10-20 m, follows. In the sequence the rocks alternate with thinne /7-8 m/ interbeds of aleurolites, argillites, more seldom-conglomerates, and with interbeds of tuffs of trachytes / albitophyres/ -in the upper part of the strata. The quantity and thickness of the sedimentary rocks increases up the sequence / up to interbedding of agglomeratic lavas with sedimentary rocks and tuffs/.

The apparent thickness of the strata is 180-190 m.

The total apparent thickness of the rocks of the Galachagar suite in the given region is 240-250 m.

The rocks, developed south-east of the pass Kotal-i-Ustur Murda, are characterized b y the following peculiarities:

Aleurolites and argillites, gray, greenish-gray, compact, thin-bedded. Sometimes they contain indistinct vegetative detrite.

Conglomerates, reddish-gray, greenish-gray, fine- medium-pebbly, compact, consisting of angular pebbles, dark green effusions and cherry quartziteslike sandstones, bindered with tufogenic cement.

Tuffs of trachytes /albitophyres/ greenish-gray, aleuro-psammitic, lithocr ystalloclastic. They consist of prevailing fragments of crystals of acidic pla gioclase, more seldom-augite and fragments of the main mass of trachytes/albitophyres/, which are in less quantity and have a piloclastic texture. The bindering mass is glassy, amounts to 60% of the rock.

In the upper course of the Rod-i-Darakht-i-Tut volcanogenic formations of the Galachagar suite overlie coarse-rubbly conglomerates of the Tagaurabat suite with with sharp angular unconformity locally /fig.22/.

The lower part of the sequence is composed of violet-red and black psephito-psammitic lithoclastic tuffs of andesites, containing interbeds and lenses / 0.1-0.2 m/ of red silica / fig.31/.

Agglomeratic lavas and lava-breccias lie over in the sequence / fig. 23/. In the upper part of the sequence of the strata many angular fragments and blocks / up to 2 x 6 m/ of albitophyres/trachytes/, epidotized andesito-basalts, quartz-amphibolic gabbro are seen besides basalt fragments. The apparent thickness of the strata is 200 m.

The summary apparent thickness of the described deposits is 210 m.

In the upper course of the first left tributary of the right component of the Rod-i-Darakht-i-Tut the sequence is similar to the described one. Dark gray, almost black plagioclase andesites /10m/ lie in the base.

Lavas and lava-breccias of basalts, including fragments of biotite-plagioclase andesites, crop out over.

In the middle course of the Darya-i-Hoja Shahab the left tributary Darya-i-Kushk the rocks of the Galachagar suite overlie brownish-red clays of the Tagaurabat suite without evident disconformity.

In the lower part of the sequence /fig.21/ andesites, among which hornblende-plagioclase andesites and plagioclase-andesites are mainly distinguished by the character of porphyric separations, crop out.

The band thickness is 30-40 m.

Agglomeratic lavas and lava-breccias of basalts lie over.

Hornblende-plagioclase andesites and plagioandesites are gray, dark-gray, violet, dark-green and massive. Porphyric separations /25-30%/ are represented by isometric grains of zonal plagioclase / from andesite to labradorite No.54/, elongated crystals of basaltic hornblende, surrounded with an opacite margin, more seldom-with grains of augite and biotite. The main mass consists of microlites of plagioclase, glass, chlorite scales and grains of the ore mineral. The main mass is hyalopilitic or micropilotaxic. Voids, different in form, filled with chlorite, are seen in the rocks.

A small outcrop of the rocks of the Galachagar suite is 10 km south of the settlement Karukh. The prevailing rocks in the sequence are gray, greenish-gray, dark-gray tuffs of andesite-basalts, containing separate rounded inclusions/ up to 20-30cm/ of gray and greenish-gray effusions / volcanic bombs/??.

In the upper part of the sequence among the tuffs interbeds of red-brown compact clays, thin-bedded platy sandstones and inequipebbly conglomerates are observed.

Tuffs of andesite-basalts are crystallolithoclastic, psammitic. Andesites, plagioclase porphyres and volcanic glass are distinguished among the prevailing fragments of rocks. Pyroclasts of basic plagioclase and augite are observed in less quantity.

As one can see from the cited material, the volcanogenic formations of the Galachagar suite can be dismembered into three bands: lower- of andesites and andesitic tuffs, middle- of basalts and agglomeratic lavas of basalts, upper- of trachytes / albitophyres/.

The band of andesites and andesitic tuffs. In the Darya-i-Gala Chagar / fig. 32/ basin the strata are composed of andesites and tuffs of andesite with separate interbeds of dacites and tuffs of acidic rocks, replacing them along the strike. The Band thickness is not large here/up to 100-120 m/.In the region of the pass Kotal-i-Ustur Murda the formations of this band are represented also by andesite. Locally,probably,the andesites are replaced by conglomerates with interbeds of tufogenic sandstones and tuffs of plagioclase andesites. /fig.33/ or pinches out / fig.34/. In the upper course of the Rod-i-Darakht-i-Tut / fig. 35/andesites or their tuffs ,up to 10 m thick, prevail in the composition of tuffs. In the basin of the Darya-iKhwayja-Shahab/ fig.36/the sequence is wholly composed of andesites/30-40 m/ and of tuffs of andesite- basalts with interbeds of clays of sandstones and conglomerates in the upper part of the sequance, 10 km south of the settlement Karukh.

The band of basalts and agglomeratic lavas of basalts.The formations of this band are spread most widely.Agglomeratic lavas and lava- breccias of basalts and basaltic potphyrites are the prevailing ones in the sequence in the western part of the region, in the upper course of the Rod-i-Darakht-i-Tut and in the Darya-i-Khwoja Shahab/fig.35, 36/. The apparent thickness of the rocks is 210 m. Interbeds of argillites, aleurolites, sandstones, and also covers of hyalobasalts were observed among the mentioned rocks east of the pass Kotal-i-Ustur Murda in the Darya-i-Gala Chagar basin / fig.32,433,34/. The strata thickness is rather large and reaches 150-200 m in most cases.

The band of trachytes/albitophyres/. These formations were fixed only in the region of the pass Kotal-i-Ustur Murda, where trachytes/ albitophyres/ ,50-70 m thick, overlie agglomeratic lavas and lava-breccias of basalts /fig. 38/. 2 km south-east of the pass Kotal-i-Ustur Murda / fig. 34/the strata of interbedding basalts, argillites, aleurolites and tuffs of trachytes / albitophyres/, isolating in the upper part of the sequence, can be conventionally attributed to the deposits of this band.

Lava flows of the Galachagar suite appertain to the flows of the platform type. Andesite lavas flowed from craters of the central type/the lavas are replaced by tuff accumulations along the strike, which is typical for eruptions of this type. But there are examples of lava flows of the same composition from volcanic apparatus of the fracturing type / see above/.

Lavas of basalts came to the day mainly along fractures, numerous and often crossing/" many-outflow fracture flows"/. The sedimentary rocks, underlying the effusions, are crossed with numerous dikes of basaltic porphyrites and augites, which can be con-

sidered as underplacing channels of flows.

Numerous breakings of crust with lava flows, which formed on their surface, brought to wide spreading of agglomeratic lavas and lava-breccias. Pyroclastic products were of the subordinate meaning in the period of these flows.

Volcanic activity in some places was completed with flows on the formed basaltic plateax of lavas of trachytes ,albitophyres and tuff products of these rocks.The centres of these flows /volcanic necks/ , observed near the pass Kotal-i-Ustur Murda, indicate appertaining the eruptions to the central type.

The described deposits of the Tagaurabat and Galachagar suites are parallel to tufogenic-sedimentary and effusive strata of the ridge Band-i-Gandao /S.D.Imanoff etc, 1962/ and appertain to the Turkestan stage.

The Turkestan age of the volcanic-sedimentary strata, overlying the Alaian deposits with erosion,is confirmed by the finds of fossil remains Ostrea lingula Rom. in its base.

The age of the effusion strata is determined from its correlation with the sedimentary rocks- it overlies the deposits of the Alaian or Turkestanian stages and is overlain by Neogene formations. Quite probable, that it can be confronted with the effusive rocks of Badhiz and Kushk regions in the USSR, where the age of the effusions is dated Eocene.

S.Popol and S.Tromp /1954/ consider the volcanogenic formations of the Herat region younger / Oligocene/ on the grounds of similarity between the series "Sabzak" distinguished by them, with Dekan trapps of India and Pakistan and volcanogenic formations of north-eastern Iran.

NEOGENE SYSTEM / N /.

KHASSANABAD SUITE /Nhs/

The deposits of the Hassanabad suite in the studied area are spread not so widely and occupy only about 150 sq.km. Their most considerable outcrops are ascertained in the western part of the investigated area, on the northern and southern slopes of the ridge Selsela Koh-i-Band-i-Baba.Their inconsiderable outcrop was fixed also in the east, on the right sides of the Harirod valley, in the zone of foothills.

The deposits of the Hassanabad suite overlie the underlying deposits with sharp erosion. On the northern slope of the ridge Selsela Koh-i-Band-i-Baba they overlie the effusive formations of the Galachagar suite of the Turkestan stage / / upper Eocene/, sharp contacts of leaning and contiguity of the deposits of the Hassanabad suite to some noses of pre-Neogene relief being observed. Such inter-

relations were seen ,for example, west of the settlement Khwoja Shahab and in other points.

On the southern slope of the ridge Selsela Koh-i-Band-i-Baba the deposits of the Khassanabad suite overlie immediately the terrigene-red deposits of the Tagaurabat suite of the Turkestan stage / upper Eocene/, which are characterized by a flattened surface.

In the east of the region ,on the right side of the Harirod valley the described deposits overlie the deposits of the Permian and middle Paleozoic age.

The sediments of the Khassanbad suite are overlain by middle and more seldom- upper Quaternary deposits: proluvial-alluvial-lacustrine conglomerates and loess-like loams only in some places with slight erosion without evident disconformity.

The deposits of the Khassanabad suite lie mainly with dip angles from 5 to 10-15°. Only in immediate proximity to mountain structures the dip angles increase up to 20 and even 30° / the upper course of the Rod-i-Darakht-i-Tut river, more gentle bedding of upper horizons in comparison with lower ones being observed in some places/ divergence reaches 10°. The above mentioned points to constant development of orogenic process in the period of accumulation of the described sediments.

We could not trace a complete and constant sequence of the deposits of the Khassanabad suite in the investigated region. A bed of white, bluish or light pale-yellow compact limestones, cloddy, with medium- and poorly rounded pebble of limestones is observed in the base of the sequence in most places.In other places alongside with limestone pebble there is pebble of argillites, sandstones and effusive rocks, usually highly destructed.The correlation of the composition of pebbly material in different sections is various. This horizon, from 2-3 to 25 m thick, is well seen in the locality by its light colour.

The uniform strata, of reddish-brown or reddish-gray in colour, consisting of interbedding of clays, gritstones and conglomerates, from the first metres to 15-20 m, lie over. The correlation of clays and conglomerates in the sequence is approximately equal.

Clays , reddish-brown, reddish-pale yellow, compact, cloddy, sometimes-poorly calcareous with different content of aleuritic, sandy and gravelly material. The latter is usually poorly rounded and consists of various local rocks, more often-effusions and red minerals of Permian age. In the clays small pores and traces of vegetation roots, prints of worm tracks, seldom-carbonificated vegetative detrite are seen. Saturation with aleuritic and sandy material is so considerable in places that the rock turns into loam or sandy loam.

Gritstones, usually reddish-gray , inequigranular, from fine- to coarse-grained, from medium - and poorly rounded fragments of local rocks, cemented with sandy- argillaceous, sometimes-calcareous cement. The gritstones contain pebbly ma material and often turn into fine-pebbly conglomerates along the strike. In places oblique bedding is noticeable in the gritstones.

Conglomerates, usually gray, consist of well and medium- rounded pebble o: of quartz porphyres, lavas of the intermediate and basic composition,different in dimensions light coarse-grained granites,red aleurolites, sandstones, limestones and other rocks. The mineral composition and different dimensions of fragmental material i n different sections are various. Near the mountain structures ons boulders, up to 0.2-0.5 m in diametre, are sometimes seen in them. In the Darya-i-Kushk-i-Khana valley lava fragments,up to 2.5 m in diametre, were observed in them. The conglomerates have usually sandy-gravelly-argillaceous, sometimes poorly calcareous cement. In the upper horizons the fragmental material is more coarse, often admixture of small boulders is contained,

The strata is brownish-gray , banded at small distances due to interbedding of clays and conglomerates.

The thickness of the deposits of the Khassanabad suite, is most considerable ,probably, on the southern slope of the Selsela Koh-i Darakht-i-Tut, where it is not less than 180 m. On the northern slope of the same ridge and in the east, in the Harirod valley it does not exceed 60 m. The mentioned thicknesses correspond to a small part of the Neogene sequence, eroded partly or completely in the considerable part of the investigated territory in Pre-Quaternary and Quaternary time.

The described deposits do not contain organic remains. Their age is determined conventionally by us, by the position in the common stratigraphic section, the character of dislocation ,etc.

Formation of the described sediments, probably, took place in intermontane areas at the foothills of rising mountains. The deposits have the character of proluvial deposits, in which impulses of positive / ascending/ movements of forming mountain structures are reflected in accumulation of coarse-fragmental pebbly-rubbly sediments, the periods of temporary stabilization- in accumulation of thinner argillaceous material.

There can be partial deposition of the described sediments in shallow lacustrine basins, periodically appearing in inetrmountain areas, which is indicated by uniformity of clays in some bands, traced for considerable distances, their calcification an and typical cloddy structure.

QUATERNARY SYSTEM / Q/.

The deposits of the Quaternary system in the investigated region are represented by exceptionally continental formations. They are rather widely , but unequally ,spread: Their distribution is limited and rather interrupted within the limits of mountain structures, which are the districts of denudation, they form more or less continuous cover in depressions and in the zone of foothills.

The thickness of the Quaternary deposits also rahges between the parts and the first metres in mountain region up to 120-150 m in depressions.

By geological-geomorphological features the Quaternary deposits of the investigated region are dismembered into three sections by us:middle, upper and recent, each of which unites different genetic types of deposits.We distinguish :proluvial-al alluvial-lacustrine, alluvial, proluvial, talus, talus-eoliam, glacial and chemogenic among the latters.

The deposits of the lower section are absent in the investigated territory.

The correlation of the Quaternary deposits of the studied region is shown in fig. 24. The deposits of the middle and upper sections with characteristic for them proluvial-alluvial-lacustrine, talus-eolian and proluvial formations, are most widely spread in the investigated region.

MIDDLE SECTION / Q_2/.

The deposits of the middle section are most wide. -spread. They fill mainly the Karukh intermountain depression, about 400 sq.km in area, and another depression, not so large in the upper course of the Rodei -Karukh. To a lesser degree the deposits of this age are developed along the river valleys. They cannot be shown on scales of geological maps in most cases.

Glacial, colluvial, proluvial-alluvial-lacustrine, alluvial-proluvial talus-proluvial and chemogenic formations are distinguished among the deposits of the middle section.

Glacial deposits/gl Q_2/, represented by moraines, were observed at the pass Kotal-i-Ustur Murda at an altitude of 2420 m/ in relation to waterline of the Rodei-Karukh 1000m/. Here they fill a small ,highly eroded corrie, have a typical for the maraine hummocky relief with drainless basins. The moraines consist mainly of poorly rounded boulders of local rocks, up to $1m^3$ and smaller boulders, included in rock waste basic mass. The moraine thickness is about 25 m.

On the northern slope of the ridge Selsela Koh-i-Dawindar/ the eastern part of the investigated area/ at an altitude of 2600 m / in relation to water line of the Rod-i-Karukh -500 m/ numerous erratic boulders, mainly of granites, measuring to 2 m^3, were observed. The nearest outcrops of granites, 3 km south of this place are isolated from it by young deep valleys. The presence of the mentioned boulders near the watershed of the ridge can be explained only by glacial transportation in the period before the final deepening of the recent erosive net. The moraines, enclosed boulders, were, probably wholly eroded, and the boulders, remained in the place, formed accumulations of proluvium.

__Colluvial deposits /c Q_2/ are spread still less, than glacial ones. They are re presented by rock waste and boulders on steep rocky slopes of the old Quaternary ero sive relief, preserved locally. They overlie partly the morainic formations on the s southern slope of the ridge Selsela Koh-i-Band-i-Baba, described before.

Proluvial-alluvial-lacustrine /pl-al-l Q_2/ DEPOSITS fill the Karukh depression and a small depression in the upper course of the Rod-i-Karukh.

In the Karukh depression these deposits lie at an altitude from I300-I800 m, reference elevation of them above water line of the rivers Rod-i-Karukh ,Rod-i-Maluma, etc is from 35- to 45 m.x/

The sequence of these deposits is the following / upwards/:

I. Conglomerates, brown-red medium- and coarse-pebbly from medium- rounded pebbles of local red rocks of Permian age, broken pebbles of granitoids, limestones,etc, bin dered with sandy-gravelly argillaceous-carbonaceous cement. This conglomerate in the region of the settlement Dalantu lies on the weathered surface of diorites -25-30 m.

2. Limestones, light, compact, of lacustrine look, cloddy, with small pebble of loca rocks, turn into conglomerate along the strike -0-2 m

3.Loams, yellow, sandy, fine-porous, calcareous, with rusty spots - 25 -30 m

4. Conglomerates, brown-gray with violet-red hue, consist of poorly rounded small and medium fragments of local rocks, not fast bindered with sandy-carbonaceous cement - 40 m.

5. Conglomerates, gray, bedded, medium-coarse-pebbly, of medium- and well rounded fragments of local rocks, they compose beds ,I-2 m, sometimes more loose or more compact with sandy-calcareous-argillaceous cement. The pebbles are oriented dis orderly. Conglomerate beds alternate with lenses and beds of sandy loam, brown-gray, or brownish-red,more seldom-loose sandstone with small and medium pebble, from 0.3 t I.5 m thick. The conglomerates prevail.Some settling of the material is observed upwards. Indistinct flat horizontal bedding is seen in sandstone lenses and in the conglomerates themselves - 60 m.

6. Conglomerates, medium-pebbly with admixture of rubbly material, fast bindered with sandy-argillaceous-calcareous cement, usually pinch out in a bench -6-I0m.

The total thickness is from I5I to I72 m.

Apparently, thickness can be considerably more in the central parts of the depression.

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x/ Along the upper margin of the scarps formed by them.

In the outlying districts of the Karukh depression fragmental material coarsens, its roundness becomes poor, the distribution in the sequence gets more disorderly, apparently, due to a great part of alluvial and proluvial material, evacuated in the depression from lateral valleys, in the composition of the deposits.

The alluvial-proluvial-lacustrine deposits in the Karukh depression, apparently, are overlain by chemogenic formations as the so called "calcareous crust", and also by loesses and loess-like loams, described below. The latters are attributed by us to the upper section of the Quaternary system.

The deposition of the described proluvial-alluvial-lacustrine formations, as we suppose, took place in a shallow lacustrine basin. This is confirmed by the presence of a limestone bed of the lacustrine type in the base of the sequence, sufficient persistence of some horizons and whole bands, the presence of horizontal bedding, and also wide distribution of these deposits within the depression without essential change of the composition. However, the influence of the proluvial-alluvial process , and at times its leading meaning, is quite evident here, that is why it is impossible to isolate lacustrine deposits .

In the upper reaches of the Rod-i-Karukh proluvial-alluvial-lacustrine deposits were observed at an altitude of 2380-2550 m; reference elevation above water line of the Rod-i-Karukh and its tributaries is 150-200 m. The thickness of these deposits ranges between 150 m in the central and 30-40 m in the marginal parts of the depression. The sequence is of less distinct and ,apparently, more uniform structure. At the bottom-loams-, yellow-brown, sandy with beds of coarse-pebbly conglomerates, with the total thickness of up to 40 m, over- conglomerates of medium- and well rounded pebble of local rocks with admixture of boulders, bindered with sandy-argillaceous-calcareous cement. The conglomerates are horizontally bedded due to sorting and different compactness of cementation. Sometimes lenses of argillaceous loose sandstones are seen. Coarser pebbly-rubbly conglomerates are observed in the upper part of the sequence as well as in the Karukh depression. Probably, fluvioglacial deposits took part in accumulation of sediments in the upper course of the Rod-i-Karukh valley.

Alluvial-proluvial / al-pl Q_2/ deposits were observed in old valleys and near-mouth parts of long rivers, such as Darra-i-Chartaq, Darra-i-Benosh, Tagab-i-Mohammad Khan, etc. When the rivers Darra-i-Chartaq and Darra-i-Benosh reached the proluvial alluvial-lacustrine plain of the Middle-Quaternary age, they formed deltas, considerably rising above the plain level. These deltas formed simultaneously with proluvial-alluvial-lacustrine deposits and differ in the composition very little. The distribution of the pebbly-rubbly material in them, is ,probably, rather various ,often-lens-like, more- of rubbly character. In the recent relief these deposits are arranged hypsometrically over the proluvial-alluvial-lacustrine deposits for 50-60 m at most. Whil

moving off the mouth their surface descends and they become one with the proluvial-alluvial-lacustrine plain. They lie at an altitude of 100 m in relation to the recent cutting of valleys.

Talus-proluvial /d-pl Q_2/ DEPOSITS ARE RATHER WIDELY DISTRIBUTED IN THE upper part of the Rod-i-Karukh, where they compose considerable sections of gentle slopes, adjacent to the axial part of the ridge Band-i-Badgisat and lie hypsometrically somewhat over the proluvial-alluvial-lacustrine deposits of the Middle Quaternary age, developed here.

By the composition these deposits are accumulations of coarse-fragmental poorly and medium-rounded material from pebbles to boulders with lenses of essentially argillaceous-sandy composition. The rocks are only local, composing the adjacent parts of the slopes. The cement is calcareous-argillaceous, calcareous with sandy-argillaceous filler Bedding is not seen. In relation to recent cuttings these deposits lie at altitudes from 60 to 80 m. The described deposits are coeval with Middle Quaternary proluvial-alluvial-lacustrine deposits and gradually turn into them locally.

Chemogenic deposits /ch Q_2/ are represented by the so called " calcareous crust", which is rather widely-spread in the investigated region.

The "calcareous crust" lies mainly on the proluvial-alluvial-lacustrine deposits in the Karukh depression as well as in the upper course of the Rod-i-Karukh, more seldom- on the talus and talus-proluvial deposits,coeval with them , near the original sides and still more seldom- on the original rocks of different age. For example,on the watershed part of the ridge Selsela Koh-i-Band-i-Zarmast and in the Tagab-i-Mohammad Khan Khan valley. The "calcareous crust" usually has the character of a bed ,from 0.4 to 2. 2.3 m thick, with distinct zonal structure /fig.25/. The lower zone is usually represented by loose ,porous , often quick, calcium carbonate with numerous fragments and pebbles of different rocks of the same composition, as the underlying ones, enclosed in it. This zone of "calcareous crust" has traces of intensive leaching. The material, evacuated from it, formed the above -lying zone, usually represented by compact limestone with distinct sintered structure of zone growth. Joint of this zone of compact limestone with the underlying loose zone is realized with numerous icicle -like projections or "beards", appeared as a result of the zone growth of compact limestone from below. The upper boundary of the zone of compact limestone is usually sharp, rather even, often has traces of secondary surface leaching. The described bizonal structure of the "calcareous crust" is usually built with two or correspondingly four zones of similar structure, but usually of less thickness.

The "calcareosu crust" is usually overlain by loess-like loams and loesses of the upper Quaternary age ,often with erosion.

The formation of the "calcareous crust" is a process, corresponding to the definite stage of geological development of the studied region with special climatic condi-

tions,appeared here at the end of middle Quaternary-beginning of upper Quaternary ep ochs. These climatic peculiarities were characteristic of the transitional period from pluvial to interpluvial,when periods of moistening changed into periods of arid ization, creating favourable conditions for chemical sálution of the before formed sediments -on one hand, for absorbihg waters, saturated with calcium salts, to surface warmed soil layers and precipitation of calcium carbonate from them, forming the upper compact zone of "calcareous crust".

The formations of the type of "calcareous crust" are widely known in other parts of Asia and Africa. The process of their formation is still at issue and is not ascertained, and more complex in details than it is given here.However,The stratigraphic side of this phenomenon is more important for us, as we think that the middle Quaternary epoch was completed by the formation of "calcareous crust", and the following period of intensive loess-formation in the conditions of progressive aridization of the climate corresponded to the upper Quaternary period.

MIDDLE AND UPPER SECTIONS, NON-DISMEMBERED /Q_{2-3}/.

The non-dismembered deposits of the middle -upper sections are spread comparatively not so widely. The talus deposits, composing trains in the base of mountain slopes and partly overlying the proluvial-alluvial-lacustrine deposits, described before,appertain to them.

Talus deposits/ d Q_{2-3}/ are represented by pale-yellow , gray-brown to pale-yellow -red loams,saturated to some degree,non-rounded fragments of local rocks.In a row of places "calcareous crust" was observed in the base of talus trains on their surface. In other cases the "calcareous crust"was overlain by talus deposits. In the recent relief these deposits are rather high in relation to the recent cutting of large valleys/40-80 m. and are intensively eroded with recent [illegible] channels.

UPPER SECTION /Q_3/.

The deposits of the upper section of the Quaternary system are spread [illegible] not so widely as the middle Quaternary deposits , and are represented by talus-eolian and alluvial deposits.

Eolian-talus/eol-d Q_3/ deposits are observed often in the Karukh depression, in the base of its mountain frame, on the northern foothills of the ridge Selsela Koh-i-Band-i-Baba and in the marginal northern and north-western parts of the investigated area, and also in the Harirod valley.

The eolian-talus deposits are represented by typical loesses and more often -loess like loams, pale-yellow with different hues. The loesses of the investigated region

do not differ from typical loesses of other regions of the Middle Asia in granulometric compositionm structural and textural features.

The loess-like loams differ in heightened content of aleuritic and sandy material, more seldom- poorly rounded gravelly and still more seldom-fine sand and rock waste material from the loesses. The coarse material forms lenses and interbeds / from parts to the first centimetres/, conditioning indistinct bedding of the rock. Porosity and columnar jointing, characteristic of loessesare typical of loess-like loams. The thickness of the loesses and loess-like loams ranges between the first metres and 35-40 m.

The loesses and loess-like loams in the Karukh depression overlie the "calcareous crust" or immediately the proluvial-alluvial-lacustrine deposits, and also the original rocks of different age.

In the foothills of the northern versant Selsela Koh-i-Band-i-Baba they overlie upper Eocene / Turkestanian/ and Neogene deposits. Their thickness in this region, probably, increases up to 50-60 m.

The formation of loesses and loess-like loams took place at the beginning of the upper Quaternary epoch in the conditions of progressive aridization of climate, to our opinion. By their genesis these deposits are of mixed eolian-talus origin, to which fine-granularity, uniformness, porosity, etc typical of loesses, on one hand, and admixture of coarse material and rock bedding, sometimes discernible, on the other hand, point.

In the recent relief loesses and loess-like loams are distributed rather high in relation to the recent cutting of large valleys/45-80m/ and are intensively eroded.

Alluvial deposits/ al Q_3/ unite the complex of middle alluvial terraces, which are traced along the largest river valleys such as Rod-i-Karukh, Rod-i-Darakht-i-Tut, Rod-i-Maluma, Darya Kushk, etc as two terrace-like benches, located at an altitude of 12-16 and 20-25m above water line /fig. 26/. The summary width of these terraces ranges between the first metres and 100-150 m, and in some cases - to 400-450 m.

In less developed valleys the alluvial deposits of the complex of middle terraces are either completely destructed by the following erosive processes or are preserved o only as small outlier scarps, scarcely discernible in the relief of valley sides.

The alluvial deposits of the middle complex of the terraces are composed mainly of pebbly, more seldom-pebbly-rubbly loose conglomerates with lenses of sandy loams and sands, containing the same pebbly material.

Coarse -pebbly conglomerates with admixture of boulders with sandy-gravelly filler crop out usually in the base mostly on the socle, composed of original rocks. Their thickness is 1-2 m. Fine- and medium- pebbly conglomerates with lenses of sand and gravel prevail in the middle part. In the upper part a bed of more coarse conglomerates with small boulders, 1.5-2.0 m thick, are seen. Pale-yellow loess-like loams with interbeds of sands, with the total thickness -1-1.5 m, overlie these upper conglomerates. Loess is usually observed on

the upper bench and is absent or very thin- on the lower bench.

The described deposits accumulated in the river valleys in two stages, corresponding to two erosive cycles, probably, rapproched in time.

UPPER-RECENT SECTIONS, NON-DISMEMBERED /Q_{3-4}/.

Proluvial and talus-proluvial deposits appertain to non-dismembered deposits of the upper-recent sections.

Proluvial /pl Q_{3-4}/ deposits of spatials flat cone debris are widely spread in the Karykh depression, where they overlie ,and locally partly cut the proluvial-alluvial-lacustrine deposits of the middle-Quaternary age, described before.

The proluvium is composed of differently round pebbly-rubbly fragments of local rocks, poorly bindered with carbonaceous-argillaceous-sandy cement. The proluvium thickness is ,probably,6-8 m. The proluvial debris cones are arranged usually hypsometrically under loesses and loess-like loams or lean to them. The recent large valleys cut proluvial trains with deep cuttings; small channels form a complex net of riverbeds, 0.5-1.5m deep and from the first metres to 20-25 m wide, on their surface/

Talus-proluvial/ d-pl Q_{3-4}/ deposits are limitedly spread and are the same proluvial formations, described before, reworked with talus process and partly overlain by talus. These deposits are observed in the marginal parts of the proluvial plain on the boundary with mountain slopes as small inclined trains with rare inconstant small furrows of temporary flows.

Talus/d Q_3/ deposits are spread not so widely. They usually compose narrow bands along foothills of dismembered mountain slopes, for example, in the upper parts of the Tagab-i-Mohammad Khan valley and in other places.

Lithologically they are represented by loams, saturated with local non-round fragmental material to a different degree, from parts to some metres in thickness. The sections, composed by them, are even surfaces, inclined in direction of valley overlapping the sides and becoming one with an alluvial-proluvial plain.

RECENT SECTION /Q_4/.

The deposits of the recent section of the investigated region are spread very limitedly. They are represented by the alluvium of the complex of lower terraces and riverbeds, proluvial and talus deposits.

Alluvial deposits / al Q_4/, united into one complex of lower terraces, include riverbed formations and are traced along the valleys of all the rivers without exception. Besides the riverbed and flood plain , two benches of terraces above the flood p

plain,I.5-4.0 m high and 6-8 m above water line, are made up of them.

The total width of the riverbed, the flood plain and lower terraces ranges between 30-35 and 500-600 m.

The deposits of the complex of lower terraces are represented by pebbles and more seldom-boulders with interbeds of sands and sandy loams.

A bed of coarser pebbly-rubbly conglomerates, up to I.0 m thick, is observed in the upper part sometimes. Loess-like rocks are absent on the surface of terrace benches;A bed of sandy loams with pebbly material, 0.5-0.8 m thick, is usually observed.

The riverbeds are usually filled with pebbles with admixture of boulders , more seldom- cobble round stone, with lenses of sands and sandy loams. The thickness of riverbed deposits ranges from the first metres to I5020 m and ,probably, more metres.

Proluvial deposits/pl Q_4/ are also widely developed. Flat debris cones in the Karukh depression, where they are overlapped by alluvial-proluvial-lacustrine deposits of the middle-Quaternary age, are made up of them.The riverbeds of all the temporary channels of the investigated region are filled with them.By the composition, roundness and other features they do not differ from recent deposuts and are represented mainly by pebbles and cobble round stone, more seldom-sands and sandy loams/ in the outlying zones of debris cones/.Their thickness is the first metres.

Talus deposits/ d Q_4/ are spread in this or that quantity everywhere, composing trains on the mountain slopes and in their foot. They are represented by typical loams with admixtube of rock waste. The thickness of these deposits ranges between parts to the first metres. These deposits are not shown on the geological map, with the exception of those sections ,where their thickness is considerable, and the area of spreading exceeds 4-5 sq.km.

CHAPTER IV. INTRUSIVE ROCKS.

Within the limits of the studied territory intrusive rocks are developed comparatively widely and compose a row of plutons/fig.27/. All of them appertain to the upper Triassic-lower Jurassic complex. There may be old granitoids in the adjacent regions. The presence of granitoid pebble in the composition of basal conglomerates of the Permian and Triassic deposits is indicative of the above said.

UPPER- TRIASSIC - LOWER JURASSIC MAGMATIC COMPLEX.

The intrusive rocks of the Upper Triassic - Lower Jurassic magmatic complex are developed in the southern part of the studied territory. They are represented by intrusions of porphyraceous biotitic granites, alaskitic granites, plagiogranites and diorites. The Upper Triassic - Lower Jurassic rocks break and metamorphize all the deposits up to the Upper Triassic./?/. Their upper age limit is unknown. However, it is known from the geological literature that the Middle- Jurassic magmatic deposits are nowhere broken by them. That is why one can naturally suppose that the making of these intrusions took place, perhaps, on the verge of the Jurassic and the Triassic, and, maybe, in the Lower Jurassic period. It is connected with the development and inversion of the "Lower Cimmerian geosyncline", spread along the northern slopes of the Parapamiz and Hindu Kush. The Upper Triassic -Lower Jurassic magmatic complex is represented by four phases. Intrusion of diorites took place in the first phase, of plagiogranites -in the second one, of porphyraceous biotitic granites -in the third one, and of alaskitic granites -in the fourth phase. Only the interrelations of diorites and plagiogranites are unknown in the investigated area. The porphyraceous granites break both of the latters, and in their turn they are broken by alaskitic granites. The diorites underwent alkaline and potassium metasomatosis. By the way, the alkaline metasomatosis took place before the potassium one. Considering the development of the magmatic centre as a whole, one can suppose that the alkaline metasomatosis took place due to plagiogranite intrusion, and the potassium one - due to porphyraceous and alaskitic granites.

FIRST PHASE.

DIORITES δ (T_3-J_1)

Intrusion of diorites took place in the first phase of the Upper Triassic-Lower Jurassic magmatic complex. With in the limits of the studied territory they compose a series of small massifs in the interfluve of the Rod-i-Maluma and Rod-i-Karikh. The diorite intrusions are confined to the northern wing of the large anticline, the core of which is situated in the axial part of the eastern end of the Sel-Sela-Koh-i-Dawindar ridge. The largest Dalanty massif / 25 km^2/ is in the vicinity of Dalanty settlement. It stretches for 12km in a sublatitudinal direction, with a maximum width of 3 km. A small stock-like diorite massif, which is, probably, an apophysis of the first one, is situated in the upper reaches of the Zangi-Odam stream, near the south-eastern end of the Dalanty massif. A row of small massifs, the largest of which reaches 3-4 km^2, are exposed in the upper reaches of of the Rod-i-Maluma river.

Within the limits of the studied territory the diorites break all the deposits up to the Upper Triassic/?/. In their turn they are broken by porphyraceous biotitic granites.

Diorite intrusions are made up of medium-grained rocks of dark gray and gray-green colour. The texture is mainly massive, The flat-parallel texture is seldom marked. They show prismatic-granular structure with the elements of the cryptic one.In the case when the rocks suffered cataclasm ,their structure becomes cataclastic or blastocemented. The grain size ranges between 0.5 and 4 mm. The average composition of the unchanged diorites plagioclase-49%,dark-coloured minerals -46% ,quartz-4%,potassium feld spar-single grains. By their material composition they correspond to melanocratic differences, approximating to gabbro-diorites. The plagioclase is represented by andesite No 45-47. It forms tabular grains, often of zonal structure. In this case the marginal borders are composed of intermediate andesine. Simple and complex twins are characteristic of plagioclase grains. The plagioclase is replaced by sericite,chlorite and is subjected to saussuritization. In some cases intensive albitization is marked. The dark-coloured minerals are represented by augite,usual hornblende,biotite,and very rare by olivine. They are in variable correlations. Reactive replacements of augite by amphibole and biotite and of amphibole by biotite are developed. Secondary changes of the dark-coloured minerals are expressed in uralitization of augite and amphibole,and also in chloritization , epitotization of amphibole,biotite,augite. Olivine is replaced by iddingsite and serpentine. Quartz is present as an inconsiderable admixture,forming small grains with wavy extinction. The accessories are represented by an ore mineral, often surrounded by a leucoxene sheath. Apatite,sphene and zircon occur more seldom.

More leucocratic and more melanocratic differences are marked as schlieren separations among the diorites. The first ones answer to normal diorites by their composition. There are about 30% of the dark-coloured . The second answer to gabbro by their composition. Less content of plagioclase /35%/ and more content of melanocratic minerals /65%/ are characteristic of them. The plagioclase is represented by labrodorite. /No 52/.

The diorites were subjected to intensive metasomatic processes. If the alkaline metasomatosis , marked before, touches only plagioclase and does not change the appearance of the rock considerably ,then the potassium metasomatosis showed stronger. The potassium feld spar develops in the rock as a whole,changing its structure. The fact that the potassium metasomatosis is later,is clear from the interrelations of the mineral formations. As a result of the potassium metasomatosis porphyroblastic and monzonitic structures are formed. The content of potassium feld spar,averaging 15-20%, reaches 60% in separate cases. The content of plagioclase lessens correspondingly. The rocks of the alkaline row appear ,which should be called by metasomatic monzonites,syenomonzonites. Diorite intrusions contain numerous small xenolites of reworked country rocks,measuring not more than 40 m in length. Endocontact changes of the diorites are expressed in the appearance of small-grained structures. Uneven nest-like distribution of dark-coloured minerals is typ-

ical. Exocontact changes of the country rocks showed in the formation of a thin zone (contact sericitic-plagioclase-quartz hornfels. Calcite-epidote and calcite-actinolite-epidote rocks, which are the result of metamorphism of carbonate schists, develop in a row of places. Garnet skarns with magnetite are marked in three places along the Rod-i Karikh, up-stream from the settlement Khwaja-Cahar-Sambeh. Acid effusions are not practically subjected to metamorphism, not taking inconsiderable sericitization and chloritization of the basic mass into consideration.

The veined series of diorites is very rich, especially in the Dulanty massif. There are dikes, stocks of acid and subsilicic rocks. The latters are younger. The acid rocks are represented by aplites and pegmatites. The vein thickness reaches 2-3 m, and the extent - first tens of metres. Their occurrance : The azimuth of dip is 330°, the angle is 15-35° and the azimuth of dip is 0°, the angle is 45°. They are composed of potassium feld spar, quartz, oligoclase. Mica, amphibole, pyroxene, ore mineral are present as admixtures. Accessory minerals are represented by sphene and seldom by ortite, which is marked sometimes even macroscopically. The basic rocks are represented by spessartites.

SECOND PHASE.

PLAGIOGRANITE. γ_I (T_3-J_1)

Plagiogranites intruded into the second phase of the Upper-Triassic-Lower-Jurassic magmatic complex. They are developed in the South-East of the studied area, where they form two massifs: Togau and Marghozor. Both massifs are confined to the large anticline, the core of which is situated in the axial part of the eastern end of the Sel-Sela-Koh-i Bawindar ridge. The togau massif has very quaint, irregular outlines in the plane, as it is broken by the Karokh massif of porphyraceous granites into two parts: western / 33 / 33 km^2/, eastern / 36km^2/. In the north the Togau massif is complicated by a large fracture. The Marguzor massif / 25 km^2/ is situated at the eastern boundary of the studied territory. Its eastern end is beyond its limits. It has an elongated form, extending for 12 km with a width of 3.5 km. From the South it is limited by a large fracture.

The plagiogranites break and metamorphize all the deposits up to the Upper Triassic /?/. In their turn they are broken by porphyraceous granites.

Plagiogranite intrusions are composed of coarse-grained massive rocks of gray-green, gray colour. The rock texture is unevenly grained, disorderly. The grain size ranges between 0.5 and 7.5 mm. The structure is granitic, locally blastocemented. Sometimes the nest-like distribution of dark-coloured minerals is observed. The intermediate composition of plagiogranites: plagioclase-52%, quartz-39%, biotite-6%, amphibole-2%. The plagioclase is represented by oligoclase No 10-12. It forms tabular separations, simple and complex twins

are typical of the latters. The plagioclase is replaced by pelite and sericite. Quartz g grains always have wavy extinction. The biotite is observed as scaly separations, the usual hornblende - as prismatic-columnar ones.Chlorite and epidote are developed out of dark-coloured minerals;apatite,sphene,zircon are present in less quantities. Phenomena of potassium metasomatosis are developed on the contact with porphyraceous biotitic granites in plagiogranites.The content of potassium feld spar reaches 30%. By their content such rocks are normal granites.

Among plagiogranite intrusions xenolites of the country rocks of different sizes and form are marked. There are especially many plagioclase intrusions in the upper reaches of the Tagau-Eri stream.Endocontact changes of plagiogranites are expressed in grain size reduction. The rock structure ,being prismatically-grained ,has the elements of the poikilitic and cryptograined structures. By the ir composition endocontact rocks approximate to diorites. Reduction of quartz content/10%/,increase ... of plagioclase content /65-75%/ and dark-coloured mineral are typical of them /20%/. Potassium feld spar of the secondary genesis is present.Locally its content sharply increases, and quartz content reduces.Such rocks by their composition answer to metasomatic syenites.The zone thickness of endocontact rocks is usually not large with a steep contact,however,they are developed at a large area in the upper reaches of the Tagau-Eri stream.It is explained, probably, by the fact that the northern contact of the Tagau intrusion is gentle,and we deal with its apical parts. The exocontact changes of the country rocks are slight. They are expressed in the formation of chlorite-sericite-plagioclase-quartz and quartz biotite-andalusite hornfels. Sometimes plagioclase-actinolite contact rocks develop. Acid effusives,as a rule, are subjected to slight metamorphism, nearly preserving their initial apperance.

The veined series is widely developed. These are dikes, stocks of acid and basic rocks. Earlier acid rocks are represented by quartz granophyres, later basic rocks -by fine-and micro-grained spessarites,more seldom-by odinites.

THIRD PHASE.

BIOTITIC PORPHYRACEOUS GRANITE $\gamma_2(T_3-J_1)$

Biotitic granites intruded in the third phase of the Upper-Triassic-Lower-Jurassic magmatic complex. They compose two large massifs in the limits of the studied territory Rudimalum and Karokh,confined to the central part of the large anticline of the Sel-Sel Koh-i-Dawindar ridge. The Rudimalum massif / 100-110km^2/ has a very elongated form in the plane. It extends from the Pahlawanna settlement to the Chashma-Obi-Garm settlement in a latitudinal direction for 32 km. The maximum width of the massif is 5 km. The Ka-

are typical of the latters. The plagioclase is replaced by pelite and sericite. Quartz g grains always have wavy extinction. The biotite is observed as scaly separations, the usual hornblende - as prismatic-columnar ones. Chlorite and epidote are developed out of dark-coloured minerals; apatite, sphene, zircon are present in less quantities. Phenomena of potassium metasomatosis are developed on the contact with porphyraceous biotitic granites in plagiogranites. The content of potassium feld spar reaches 30%. By their content such rocks are normal granites.

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The Karokh massif/ 55km^2/has a more isometric form in the plan. It composes a watershed ridge north of the Chashma-Obi-Garm and extends in a latitudinal direction for 12 km with the maximum width of 5 km. North of the Rod-i-Karakh valley two small massifs /up to 1 km^2 of biotitic granites are in the upper reaches of its right tributaries Tagaw-i-Mahammad-Kh Khan and Darrah-i-Cartaq. The eastern end of one more massif is observed in the far south-east in the lower reaches of the Tagaw-i-Sora-Gird. This massif is situated to the south-east beyond the limits of the studied territory.

The biotitic granites break and metamorphize all the deposits up to the Upper-Triassic/?/,and also diorites and plagiogranites of the first two phase of the given complex. They in their turn are broken by [illegible] alaskitic granites.

The Karokh and Rudimalum massifs are made up of very uniform granites by their appearance and material composition. They are pink-gray,light-gray,yellow-white,gray porphyric rocks for the most part. Mattress -like jointing is characteristic of them. Porphyraceous separations,measuring from 5mm to 30 mm ,ammount to 5-15% of the whole rock. They are composed of potassium feld spar, for which simple twins are characteristic,as well as perthitic structure. It is caolinized. The porphyraceous separations are,probably, of metasomatic origin. Often they have uneven margins,which intrude into the basic mass by separate branches. The minerals of the basic mass, remained as outliers relics, are observed inside porphyroblasts. The medium-grained basic mass is of granitic structure and is composed of grains ,measuring 0.5-4 mm. The texture of the basic mass is disorderly. Its intermediate composition: plagioclase-21%,quartz-28%,potassium feld spar-36%,biotite-5%. Single grains of usual hornblende and pyroxene are marked locally.The separations of subzonal plagioclase are pelitized and are made up of oligoclase. Quartz grains usually have wavy extinction. The potassium feld spar of the basic mass is often of twin and perthite structure. It is caolinized. The biotite forms scaly separations, replaced by chlorite and epidote. Accessory ones are represented by the ore mineral and sphene,apatite, zircon,allanite are present in less quantities. In some cases the reduction of feld spar content and quartz content are marked correspondingly up to 40% and 20%, increasement of oligoclase content -up to 35%.The rock acquires an intermediate apperance between biotitic granite and adamellite. The latters compose places among biotitic granite intrusion and are connected with them by gradual transitions.

Biotitic granite intrusions contain numerous xenoliths of deeply reworked country rocks. Their size in length ranges with in wide limits from 0.2 m to 7 km. Small xenoliths are arranged with any orientation, large ones are subordinated to the general structural plan of country sedimentary strata.Especially a great quantity of xenoliths are observed in the middle part of the Rudimalum massif, in the watershed of the rivers Rod-i-Malum and Tagaw-iSora-Gird. It is ,probably, explained by the roof sag,and we deal with apical parts of this intrusion.

Endocontact changes of the biotitic granites showed slightly.Even in the immediate approximity

to the contact they are still porphyraceous, medium-grained. Large porphyroblasts are composed of potassium feld spar in them . However, reduced quartz content/15-20%/ and increased content of the dark-coloured mineral/8-10%/ are characteristic for them. Their peculiarity is in the material composition, by which they occupy an intermediate position between biotitic granites and quartz syenites. Endocontact changes of biotitic granites on the contact with plagiogranites and diorites of the first two phases of the described complex are expressed in appearance of aplite-shaped, fine-grained granites, characterized by increased content of oligoclase /35-40%/. The rocks acquire their usual appearance at 30-50 m from the contact. Biotitic granites exert a very strong influence on the country rocks. The scale of these processes is in direct dependence on the character of the contact. Contact hornfels develop with the steep contact . Their thickness does not exceed the first hundreds of meters. The thickness of the zone of changed rocks increases sharply with the gentle contact. Alongside with this migmatized rocks, the distinctive feature of which is leaf-by-leaf and ptygmatic injection of granitic materials, develop. Macroscopically they are banded, often plicated rocks of dark-gray, black and gray colour. Their structure is granonemanoblastic, granolepidoblastic; the texture is schistic. They are composed of amphibole, plagioclase, biotite, sometimes of quartz. Thin garnet skarns with magnetite develop in the zone of exocontact of the small massif in the upper reaches of the Tagaw-i-Mohammad-Khan.

The veined series of biotitic granite intrusions is slightly developed. It is represented by rare veins, aplite dikes and dikes of pegmatites and later lamprophyres of sublatitudinal extent. The dike thickness does not exceed 1-5 m. Aplites are micro- and fine-grained rocks of light-gray and white colour. Single pegmatitic veins with garnet, up to 4 m in thickness, were observed north of the Chashma-Obi-Garm settlement. The lamprophyric dikes are made up of micrograined malachites. Thin veins of milk-white quartz are observed in the zone of exocontact of biotitic granite intrusions.

Summing up the above said, one should mention that small , up to 2-4 cm thick interbeds of calcite with chalcopyrite, malachite and azurite are marked in the endocontact part of t the Rudimalum massif in the middle stream of the Rod-i-Maluma . However, large ore manifestations are not met.

FOURTH PHASE.

ALASKITIC GRANITES $\gamma_3(T_3-J_1)$

Alaskitic granites intruded into the fourth phase of the Upper Triassic-Lower Jurassic magmatic complex. They are developed on the extreme south-east of the studied territory, where they form two small massifs. The first of them /1.5 km^2 in area/ is a little to the north of The Chashma-Obi-Garm settlement, and the second /4 km^2 in area/ is in the lower reaches of the Tagaw-i-Sora-Gird river. However, only the eastern part of this massif is situated here,

Which is developed wholly to the west, beyond the studied territory.

Alaskitic granites break the Paleozoic deposits and also biotitic porphyraceous granites. Their upper age limit is unknown.

Macroscopically the alaskitic granites - light-grey, white porphyraceous rocks, often slightly-gneiss-like texture. Porphyraceous separations of potassium feldspar, measuring 3-8 mm, are , probably, of metasomatic origin. They amount to 20% of the whole rock. Medium-grained basic mass is composed of grains, measuring 0.2-2.5 mm and are of granitic structure with the elements of the pegmatoid structure. Its intermediate composition: plagioclase - 30%, potassium feldspar - 24%, quartz - 23%, biotite - 3%, muscovite - single grains. The plagioclase forms tabular separations, of twin structure. It is represented by oligoclase. The plagioclase is fresh or is slightly replaced by sericite. Xenomorphic separations of potassium feldspar are often of perthite structure and are caolinized. Quartz grains have wavy extinction. Scaly separations of biotite are replaced by chlorite. The muscovite composes single flaky separations as well as aggregates of small flakes, often of mica, form nest-like accumulations. The accessories are represented by the ore mineral, apatite, sphene, zircon, allanite. The alaskitic granites are locally broken down and cataclastic or blastocemented structures develop in them.

Endocontact changes of the described granites were expressed in appearance of a thin zone of fine-grained rocks / grains, measuring up to I.5 mm/, which have cryptic or aplitic structures with the elements of the pegmatoidal structure. Complete disappearance of mica which are observed as single flakes , are characteristic of them. Exocontact changes of the country sedimentary rocks were expressed in the development of the thick zone of migmatites, which are quite similar in macro- and microscopically to the migmatites. The latters formed at biotitic granite intrusions. Exocontact changes of biotite granites did practically not showed.

The veined series of alaskitic granites is slightly developed. It is represented by rare thin aplitic veins of sublatitudinal strike.

HYBOABYSSAL INTRUSIONS

Hypoabyssal intrusions are represented by dikes , veins and small rods. Among them are distinguished the group of intrusions of Mesicenozoic age, closer of indefinite age and intrusions of Upper Eocene age.

Non-divided hypoabyssal intrusions of Meso-cenozoic age.

At the southern versants of the Sel-Sela-Kokh-i-Bandi-Baba and Band-i-Zarmast ridges dikes, rods and veins, made up of andesitic porphyrites, seldomer diabasic porphyrites, seldomer quartz porphyres, are widespread. The rods are found to the north of the Beras-Barrkh village. They are oval in shape, area being up to 50 sq. m. Dikes and veins are more often spread. They strike northeast and northwest. One part of them is genetically connected with the Upper Eocene volcanism, and the other - with the Triassic one. However their dismembering is being difficult because of similarity of their material composition.

Hypoabyssal intrusions of the Upper Eocene age.

Hypoabyssal intrusions, connected with the Upper Eocene volcanism, are represented by small rods and dikes. The rods are developed in the south-western part of the investigated area, south of the Karukh village. In the plane they are of slightly oval shape, the area being to 200-250 sq.m. The dikes are developed in the northern part of the studied area, in the vicinity of the Gala-Chagar village.

As usual they have submeridional strike and being traced for 100-200 m along the strike, the thickness being 5-10 m.

The Upper Eocene small intrusions are made up of andesite porphyrites, basaltic porphyrites and diabasic porphyrites. They absolutely do not differ from their flown analogues, making the Gelosum suite, according to their material composition.

CHAPTER V. TECTONICS.

The regional tectonic of Northern Afghanistan and, in particular, of Hindu Kush with its western end -Paropamiz is not worked out up to now.

The first serious generalizations on paleogeography and tectonics of Afghanistan are contained in the work by B.A.Petrushevski /1940/."The tectonic sketch of Afghanistan and the adjacent districts of the USSR", given by this investigator, reflects the tectonic position of the investigated region in the zone of structures of "young Cimmerian geosynclinal folding", from our point of view.

Later Ju.P.Chepoff /1961/ compiled the tectonic sketch of the interfluve Harirod Murghab, which overlies the area, investigated by us, with its southern part.inconsiderably. The "Laman nose", and west of it "Chalkhara trough" with the Kuloji anticline, situated immediately in the northern foothills of the ridge Selsela Koh-i-Band i-Baba, are discenible in the east of the region in the map.

On the grounds of wide geological investigations in Northern Afghanistan A sketch tectonic map of Meso-Cainozoic deposist of Northern Afghanistan" is compiled lately by Roschin /1964/. According to this sketch the marginal northern part of the investigated region is treated as a zone of the trough /The Kanara trough/within the limits of the epiplatform orogenic zone, covering the southern end of the Karakum epihercynic platform. The northern versant of the Selsela Koh-i-Band-i-Baba is treated as a zone of front folds of Paropamiz, and the whole district south of it, as "paleozoic frames".

The examined sketches of tectonic give the general idea of the position of the investigated area in the structure of Northern Afghanistan.

Our investigations showed /fig.32/,that the main elements of folding structures observed in the studied territory, formed mainly as a result of tectonic movemnets of the Variscian and especially Cimmeriam stages of folding. The Alpian movements were rather intensive here,but they manifestated mainly in movement of masses along steep rupture dislocations.

The territory, investigated by us, does not cover the district of development of old formations, and that is why we do not know anything about the movements, connected with Caledonian phases.

Variscian tectonic movemnets and structures, made by them.

The oldest deposits, seen in the investigated territory, appertain to Middle Paleozoic/ probably, to the very bottoms of Carboniferous and the tops of the Devonian system/. The deposits are of large thickness / over 3000 m/ and very monotonous in

in composition, are overlain by the deposits of the lower Carboniferous Palawan suite /C_I t-n/. The latter lies on the middle Paleozoic in different sections of the region in a different way. In the middle course of the Maluma r./ on the northern versant of the Selasela Koh-i-Dawindar/ no unconformity or evident erosion were noticed between these strata. At the same time in the upper reaches of the Maluma r. a bed of basal conglomerates lies in the base of the Palawan suite, and angular unconformity reaches 20 and azimuthal one -10-15°. This points to local manifestation of tectonic movements on the boundary between the Devonian and Carboniferous systems, which have not created somewhat considerable structures at a large territory in the investigated region.The folding structures, which can be attributed to this stage of tectonic movements,are of a latitudinal strike,inclining to north-eastern , and dip angles on the wings do not exceed 20°/ the middle and upper course of the Maluma r./. In this phase comparatively gentle folds formed. Later on they were considerably reworked. That is why monoclines with dip angles from 30 to 80° are more characteristic for these deposits.in the recent structure.

Apparently, the erosion of tectonic structures, formed as a result of these movements , was without forming land and had an abrasive character.

The deposits of the Middle Paleozoic is distinguished as an independant structural substage /fig.32/.

The following submergence of the region caused the beginning of a new sedimentation cycle, enveloping Turneian, Viseian and Namurian ages.This cycle begins from basal conglomerates/ not everywhere/, coesisting of well round quartz pebbles, gray quartz-like sandstones and acid effusions, i.e. chiefly local rocks, which points to inconsiderable carrying of materials.The above located sequence of the Palawan suite indicates an unstable tectonic regime of the sea basin with a tendency to regressiveness/ schists, conglomerates, sandstones, limestones, coal/. At the end of the deposition of the Palawan suite / Namurian age/ the regression reaches its maximum. The southern part of the territory is a lagoon, in which a great quantity of plant material,which caused formation of coal beds, deposited alongside with pebbles and sands. Very slight tectonic movements, manifestated locally, are seen at the end of Namurian. They did not cause evident crumple of the Palawan deposits, however, brought to their partial erosion.

In the middle Carboniferous period the region experienced total submergence. It was more considerable in the south / limestones, schists/ , and , probably, it was less in the north / schists, coaly schists, sandstones, limestones/. On the whole,there is some stabilization of the tectonic regime in the Middle Carboniferous.

The most sharp manifestation of orogenic movements took place in the period between the Middle Carboniferous and Permian. All the folding breaks or their prevailing quantity were formed in this phase. They are observed among the Carboniferoud deposits of the Palawan and Sangizard suites. Folding is of the linear character and has a latitudinal strike of the structures axes to north-east. The dip angles of the rocks on the wings of folds range more often between 30 and 60°, more seldom-75-80°. The assymetry of the folds is pronounced not so clearly: the southern wings of the anticlines are somewhat steeper, than the northern ones. Apparently, overturning of the anticlines to south took place, as it is observed, for example, in the upper reaches of the Maluma r. The character of folding in the deposits of the Palawan and Sangizard suites is shown in fig. 33.

Sometimes an isoclinal character of folding is observed, though we are not sure in its primary origin/ probably, it is of later origin and connected with numerous ruptures of the Post Triassic age, as some general crumple of the rocks.

Folding in the deposits of the Palawan and Sangizard suites, was, probably, essentially complicated later on, however, the character of these complications cannot be ascertained, as the direction of the structures, appeared here, later on, has an inherited character and rapproches to latitudinal with a deviation to north-eastern, as it was already mentioned.

We have not observed rupture dislocations, the age of which could be fixed exactly as Pre-Permian. Probably, they were not typical of this phase of folding, or experienced renovations in the following periods and that is why they cannot be distinguished.

The dislocated deposits of the Palawan and Sangizard suites are distinguished by us in the upper structural substage of the Middle Paleozoic structural stage on the given tectonic sketch/fig. 32/.

As a result of the tectonic movements of the described phase, probably, land formed, which was subjected to erosive-denudation processes then. The mountain relief, formed as a result of it, was not levelled finally up to the beginning of the Permian sedimentation cycle, which is proved by immediate observations of the upper Carboniferous Paleorelief in the region south of the settlement of Palawana/ / relic mountain , composed of Sangizard limestones, protruded over the base of the Permian red minerals for 100-200 m/.

The Permian period is characteristic of rather sharp submergence of the region accompanied by thick accumulation of terrigene red deposits and subordinate limestones, with the total thickness of over 3500 m. The removal of materials began, probably, in the south, in the uplifted districts of Central Afghanistan, experienced an essentially continental stage of development in this period. At the end of the

Permian period -in the beginning of the Triassic the terrigene sedimentation is added with effusive activity, manifestated, probably, in immediate proximity to the investigated region.

The end of the Permian e- the beginning of the Triassic was characteristic of a new sharp manifestation of tectonic movements, which were inferior to the preceding ones in intensity. The region was again elevated above sea level. The structures, created by these tectonic movements, were again subjected to deep erosive shearing.

The folding structures/ fig. 34/, formed by these movements, have a latitudinal or sublatitudinal direction of axes, repeating the strike of the structures of the upper Carboniferous folding. There are deviations in the strike of fold axes to north-east, for example, on the southern versant of the Band-i-Badguissat. The dip angles of the rocks on the wings of the folds are more often within the limits of 30 and 60°, sometimes they are more gentle /15-25°/, more seldom-they are steeper/ up to 80°/. Fold assymmetry is observed seldom:the southern wings of the anticlines are steeper, than the northern ones. In one case an overturned to south fold with dip angles in the wings up to 40°/ / north of the settlement of Khwaja Chor Shambe/ was observed.

Besides fold dislocations, clearly pronounced, monoclines with dip angles from 25 to 60° are often observed. They are usually limited with rupture dislocations. The monoclines with bed dip angles to south have steeper dip angles, than at dip to north. Rupture dislocations of the Permian age were not ascertained.

On the whole, comparing the dislocation of the Permian deposits with the Lower-Middle- Carboniferous, one can mention its more gentle and quiet character. Isoclinal folding is absent in the Permian deposits.

In correlation of folding dislocations of the described structural stage with the structures of the underlying one, with preservation of their general direction inversion of structures is seen. For example, in the region of the Palawan coal deposit it is clearly seen that the synclinal fold, composed of sangizard limestones, is located in the vault of the anticline, made up of Permian rocks/ fig.54, sequence/. Dip angles in lower- middle Carboniferous as well as in Permian deposits are of the same value/30-40°/. In the upper part of the left component of the Darra-i-Chartaq in the fold core composed of Permian rocks and having dip angles up to 60° crop out monoclinally dipping rocks of the Sangizard suite crop out at angles of 30-40°. It is clear from these examples, that in a row of cases the Permian dislocations, superposing the middle Carboniferous, did not stregthen them, but weakened them. That indicates the absence of inhehitedness of the general structural plan.

The phase of folding in the end of the Permian- the beginning of the Triassic completed in a comparatively short interval of time, i.e. the uplifts, formed by it, were already eroded and levelled partly in the Indian age, and the total submergence of the investigated territory was outlined. Posterior tectonic shifts, brought to

the initial stage of erosive-tectonic basins and manifestations of effusive activity, displayed at this time. Red terrigene deposits with rare subsidiary limestones, indicating aquatic, perhaps, marine origin of these sediments, accumulated in erosive-tectonic basins.

Later on the region experienced constant submergence,

In the Olenek age the marine transgression reached its maximum. Typically marine sediment accumulated, apparently, up to the upper Triassic.In the east of the region their accumulation was accompanied with intensive volcanic activity/ at any rate, in the lower Triassic/. The total thickness of normally sedimentary and effusive sediments accumulated during the lower and middle Triassic, is over 1500 m.

CIMMERIAN TECTONIC MOVEMENTS AND STRUCTURES,MADE BY THEM.

The first movements of the Cimmerian stage of folding manifested at the end of middle-the beginning of the upper Triassic. These movements were of clearly orogenic character.The folding, formed by them, is very gentle, but as a result of considerable scale of uplifts, the depth of erosive cuttings of structures is rather considerable and reaches 1000 and more metrese at short distances.

As the lower-middle Triassic deposits are rather limitedly spread in the investigated territory, it is very difficult to speak of the character of folding and other dislocations. There are only some folds , which can be considered as those that were made in this phase of folding. These structures have mainly a sublatitudinal or east-north-eastern direction. The largest and clearly pronounced anticlinal fold, composed of lower-middle Triassic deposits, is observed in the middle course of the Rod-i-Maluma. This fold has dip angles on the wings 30-40° and is cut by the upper Triassic deposits, overlying it, at an angle up to 15°.

The distinct synclinal fold, composed of the rocks of the lower part of the Jawza suite, is observed in the upper course of the Darra-i-Chartaq;The dip angles of the rock rocks in its wings reach 30-50°.

The third fold of the anticlinal structure is seen in the upper part of the Tagab-i-Jari. The rocks. composing it, of the Jawza suite dip in the wings at angles:40°- on the southern wing, and 60°- on the northern one .

Besides the described folds monoclines with dip angles 30-40° to the south and to the north-west are observed along the left bank of the Rod-i-Maluma and in the middle course of the Darra-i-Benosh.

Rupture dislocations of this age are not ascertained for sure.

The upper Triassic epoch is characterized by intensive submergence of the region. The hystory of the geological development of this time is divided into two stages, shar

sharply different from each other.

Thick / up to 3000 m/ red coarse-terrigene deposits deposited in the first /early/ stage, and rare eruptions of andesites of the Galasum suite took place. Rare beds of limestones among these rocks indicate aquatic , probably, marine conditions of the accumulation of these formations.Andesitic lavas and their pyroclastic derivatives of the Tutak suite / over 1000m/ accumulated in the second / latest/ stage. Probably, As a whole, the sequence of the upper Triassic is much thicker. One can suppose that effusive masses erupted in the Ratian age and partly in Laiess, as in other regions of Afghanistan.

New tectonic movements, which were of the orogenic character and were accompanied by the total considerable uplift of the region, took place in the beginning of the lower Jurassic.This is confirmed, as a rule, by a deep erosive shear of structures, up to the complete washing off of the strata of the Triassic deposits.

Intrusion of masses of granodioritic and granitic composition took place simultaneously or at the end of the main stage of folding. The intrusive masses are controlled by folding structures and possess an elongated form in a sublatitudinal direction in plan/The Rodimaluma massif, etc/.Some part of intrusions are of the lower Jurassic age.

Folding structures, formed in the lower Jurassic epoch of folding, are distinguished at very limited sections, due to their ommission from the sequence in the great part of the investigated territory of the upper Triassic deposits.

West of the Rod-i-Maluma in the region of the settlement of Tutak, the upper Triassic deposits lie mainly monoclinally with dip to north-west at angles 60-40°. Only a small synclinal fold with an axis of the north-eastern strike is observed among them.Beds dip at angles 35-40° in the wings of this fold. The north-western wing of the fold is broken with a rupture, having the character of an upthrow fault with the azimuth of the dip of the surface displacement-340°, at an angle-85°.

Probably, this dislocation has the Lower Jurassic age.

East of the coal deposits of Madjed-i- Chob-i- the upper Triassic deposits are broken with numerous rupture dislocations of the east-north-eastern strike. However, the age of these dislocations is not clearly ascertained and can be younger.

The described lower Jurassic phase of folding is, probably, pronounced most sharply and completely in the investigated region among other phases of the Cimmerian stage. Thick effusive manifestations,preceded to it,intrusion of masses in the process or at the end of folding, and ,at last, a great depth of the following erosive shears, nearly completely destructing the thick strata of the Triassic deposits, and, probably, partly stripped the plutons of the erupted rocks then, point to this.

The geosynclinal or near to it period of the development of the Investigated territory concluded with this stage ,which we consider here the main one. As a result of this,its massif of the epihercynic karakum platform , situated to the north, was brazed with the old Iran-Afghan massif, located south of the Harirod valley.

In the attached tectonic map/fig.32/ the Triassic structural stage is divided into two structural substages in accordance with the given description:lower- unites the structures, composed of the deposits of the Lower and Middle Triassic, upper one= of the Upper Triassic.

The new stage of sediment-accumulation began only in the Middle Jurassic.By this time the mountain structures were levelled and the investigated region was,probably, a near-sea plain with lagoons, adjacent to it,where sandy-argillaceous deposits and abundant plant outliers, which formed beds of coal here,had accumulated/Madjed-i-Chob-i/.

It is very difficult to ascertain the full thickness and the composition of Middle-upper Jurassic deposits, because they were essentially eroded in pre-Albian time.

The geological hystory of the region is not known since the Middle Jurassic to Albian, because the deposits of this age are absent here. We can speak with certainty only about manifestations of Late Cimmerian phases of tectonic movements in this time, as a result of which the region was highly uplifted and experienced the continental stage of development. Rupture dislocations and relative displacement of blocks by them were the distinctive feature of the tectonic movements of this period. Dislocations by folding were of the subordinate near-fractured character .

The rupture dislocations of this age of upthrow faults and seldom-of steep overthrusts are ,probably, spread rather widely in a series of sections of the investigated region. However, Their exact age is fixed only in the region of the Madjed-i-Chob-i- coal deposit. Here a whole system of ruptures of the NNE strike is located in the deposits of the Triassic and Middle Jurassic and is overlain by non-disturbed deposits of the Albian period. These ruptures dip south-south-east at angles from 60-70 to30-35°. Besides, there are ruptures of the strike, near to meridional:they,are, probably, near to the above mentioned, as interrelative displacements of both of them.Along the ruptures of this age, south of the Madjed-i-Chob-i deposit the deposits of the Middle Paleozoic come to the day in the core of a large anticline, composed of Permian deposits.

A good example of manifestations of near-rupture folds of this age in the Middle Jurassic and Lower Triassic deposits is south of the South-Eastern section of the Madjed-i-Chob-i coal deposit /fig.35/. Here along the steep rupture, which turns

into an overthrust with dip to south, the Middle Jurassic deposits are hitched up, and the lower Triassic deposits, contacting with them along the rupture ,are crumpled into a steep anticlinal fold. The rupture and the crumpled middle Jurassic and lower Triassic deposits are overlain by non-disturbed gently lying rocks of the Albian peri

Due to sharp manifestations of late Cimmerian movements and deep following shear of the structures , made by them, the deposits of the middle Jurassic and partly Tria sic age are wholly eroded in the investigated territory. The middle Jurassic deposit are partly preserved only at an inconsiderable area in the upper reaches of the Rod-i Karukh, within the limits of a relatively subsided tectonic block . Apparently,the blo character ,shifted to the Late Cimmerian phase conditioned a very slight/ about 2°/ a ular unconformity between the deposits of the middle Jurassic and Albian, with the ex ception of those sections, which are adjacent to rupture dislocations, as it was men tioned above. Nevertheless,their general significance is the grounds to isolate the deposits of the Middle Jurassic into an independant structural substage,which will be confirmed at the investigation of the adjacent regions.

ALPINE TECTONIC STRUCTURES AND STRUCTURES,MADE BY THEM.

The mountain country, formed as a result of Late Cimmerian tectonic movements and the following erosive-denudative processes, was levelled to the Albian stage. Wave abrasion of the trasgressive Albian sea caused the final flattening of the surface. Beginning from the Albian age and in the following time the region subsidence caused the accumulation of thick strata of the lower-upper Cretaceous ,typically marine de-posits in its northern half.

In the first stage / Albian,Senoman,partly Turonian/ the sediments were of the mi mixed terrigene-carbonaceous character, in the following time / from Turonian to the first half of the Maastrichtian stage/-were exceptionally carbonaceous or argilla-ceous-carbonaceous. Apparently, The sea did not cover the whole investigated territory Probably, its southern half was land. The presence of essentially terrigene facies in the upper Cretaceous deposits, for example, in the middle course of the Darrakh-i Benosh, on the southern versant of the Selsela Koh-i-Band-i-Baba indicates it, for example.

In the middle of the Maastrichtian age tectonic movements ,which were of the ascending epeirogenic character,are observed in the investigated territory. In the north-east they caused inconsiderable erosion within the Maastrichtian stage;in the north-west this erosion was more considerable. As a result of it,one can observe sharply transgressive superposition of the upper part of the Maasrichtian immediately on the Turonian-Senoman,Albian or even Triassic. /fig.15/.These movements have not created any evident structures. However, some convergences in strikes/ up to 15-20°/

of Cretaceous rocks, accumulated before these movements and after them, can be marked out in the attached sketch tectonic map / fig.32/ in the basin of the Laman / the north-eastern part of the territory/.

The sedimentation in the second half of the Maastrichtian stage, mainly of the terrigene character, sometimes with gypsum, turns into limestones and sandy limestones in the Danian-Paleogene in the north-east of the region and calcareous sandstones, gritstones and even conglomerates in the north-west. Apparently, the mentioned facial replacement is conditioned by the removal from land, existed here in the beginning of the upper Cretaceous, [illegible]. The marine conditions of sedimentation continue to exist up to the end of the Alaian age / Middle Eocene/. The thickness of the sediments, accumulated for this period of time/ the upper part of the Maastrichtian-Alaian stage/ is about 500 m.

The Turkestanian age / the first half of the upper Eocene/ is characteristic of sharp uplift of the region and regression of sea. The tectonic movements of this time caused the formation of gentle folds in the upper Cretaceous and Paleogene /up to upper Eocene/ deposits of the sublatitudinal strike with the prevailing dip of beds in the wings from 5 to 20°. Sometimes there is assymmetry of folds: the northern wings of the anticlines are more gentle than southern ones. Folds in the upper Cretaceous-Paleogene deposits / up to the upper Eocene/ are more often observed in the north-west of the region; gentle monoclines with beds, dipping from 4-5 to 12°, are more typical for the north- east of the region.

The mentioned tectonic peculiarities of the Cretaceous-Paleogene deposits favour distinguishing two structural substages among them. The lower one, enveloping the interval of time from Albian to the first half of the Maastrichtian stage, and the second one -from the second half of the Maastrichtian up to the Alaian inclusive.

The differences of the structural plan of these substages are inconsiderable. However, unconformity, with which the upper structural substage overlies the lower one, reaches a considerable value, up to the complete omission of the rocks of the lower structural substage from the sequence.

The deposits of the Turkestanian stage are most widespread in the west of the region, which intensively submerged at this time, apparently. In the east of the region they did not accumulate at all, to which sharp coarseness of the material in the region of the settlement of Tagau Rabat in comparison with more western regions, points.

The geological hystory of the Turkestanian age are divided into two stages. Thick/ up to 800-1000 m/ coarse-terrigene red minerals were observed in the first stage; lavas of the intermediate and subsilicic composition flowed in the second stage.

Coarse- terrigene red deposits / Tagaurabat suite/ accumulated in aquatic conditions and are, probably, the sediments of the deltaic type.

The effusive formations / the Galachagar suite/ overlies the rocks, underlying them and also the deposits of the Tagaurabat suite often with unconformity, with contacts of resting on ,etc.This points to the tectonic ascending movements, preceded to them,and manifestation of erosive-denudative processes, brought to the formation of the relief, on which lavas of the Galachgar suite flowed in continental conditions . The flows were mainly of the fractured character.

Gentle folds of the meridional direction with dip angles of the rocks in the wings from 5 to 30,more seldom-40° were formed,apparently, in the final stage of flows in the northern part of the region.These folds are of very limited development.However, superposing the earlier / pre-Turkestanian/ folds of the sublatitudinal strike they form original structures of " [illegible] swell", observed in other regions of Northern Afghanistan.

The formations of the Tagaurabat and Galachagar suites correspond to two different stages of the tectonic development of the region in the upper Eocene, in connection with which they are divided into two structural substages by us.

The hystory of the geological development of the region in Oligocene is not ascertained because of the absence of the sediments of this age.Apparently, at this time the region experienced the general ascending movement and movements of separate blocks along rupture dislocations.Probably, The main shifts of the Bandibaba and Dawindar systems of ruptures took place just at this time. These ruptubes sharply break the Turkestanian deposits, bringing them in contact with the Triassic and middle Triassic deposits;the Permain and Triassic deposits are in contact with the Cretaceous and Paleogene deposits as one can see from the attached tectonic sketch. As a result of block shift along these ruptures, which are sometimes of the complex structure /fig.39 and 40/numerous near-rupture folds of different aspects appear/fig.36, 37/. Besides, gentle, sometimes flexure-like folds/fig.38/, breaking the Cretaceous-Paleogene deposits beyond the evident connection with the ruptures of the usually sublatitudinal strike, appeared in the same period, probably.

Some branches of the above mentioned ruptures are overlain by slightly dislocated Neogene sediments, as it is observed, for example, in the Tagab-Jari valley, in the south-east of the region,which confirms their pre-Neogene age.

It is quite clear to us that such mountain structures as the ridges Selsela Koh-i Band-i-Baba and Selsela Koh-i-Dawindar and the depressions, situated between them, had their morphological definition in Neogene already. Their appearance is connected with tectonic shifts first of all, which are located along the ruptures of the above called systems.

The terrigene deposits of the Khassanabad suite accumulated in small aquatic basins in intermontane depressions in Neogene.

Change of dip angles of the beds in the sequences of the Khassanabad suite while approaching the mountain structures points to continuing height of mountains in this period of time.

The post-Paleogene/ post-Khassanabad /tectonic movements were of the same character, i.e. mainly manifested in displacement of blocks along ruptures, located before /probably, Oligocene/ as well as appeared again. These ruptures touched also the deposits of the Khassanabad suite, but they are negligible by their scales, probably.

The tectonic movements along the ruptures of the latitudinal strike manifested intensively in the Quaternary period, of which numerous observations of the dislocations of the Quaternary deposits up to the recent ones are indicative./fig.41, 42/.

CHAPTER VI. GEOMORPHOLOGY.

The investigated territory is a part of the typically mountain country, highly uplifted above sea level and intensively broken.

The formation of the recent relief began from the end of Paleogene/Oligocene/, when orogenic movements manifested especially intensively and brought to very considerable uplifts of the region, continued in Neogene, and then in the Quaternary period up to the present moment. During this time prevailing ascending movements were changed by descending ones twice at least. Besides, these movements were not uniform by intensity and amplitude in the different sections of the region.

Some sections, for example, the Karukh[illegible] intermontane depression and also the valley, of the recent Harirod, located beyond the limits of the work region, and vast subsided spaces north of the ridge Selsela Koh-i-Band-i-Baba fell behind the general ascending movement, and in some stages of tectonic development they experienced relative subsidence. This caused great contrast of reference elevations, which predetermined sharp manifestation of exogenic processes and, erosion and denudation-in the first place. These processes manifested most of all within the limits of relatively uplifted sections with the formation of the erosive and denudative relief. In the intermontane depressions and submontane plains accumulation of destruction products with the formation of chiefly accumulative land forms took place.

The cited reasons conditioned the exceptional complexity of the geomorphological structure of the investigated territory.

The relief of the studied region can be divided into four genetic categories by the main relief-forming processes:

A. Erosive-tectonic types of the relief-the tectonic factor is the main in their formation/ uplift/as well as erosive activity of aquatic flows.

B. Denudative-erosive-tectonic relief types-tectonic and erosive factors as well as denudative ones/plain washing out/ are the main in the relief -formation.

C. Structural-denudative relief types-denudation is the main one; structure and peculiarities of lithology predetermine the form of the denudated surface.

D. Denudative-accumulative relief types-accumulation is the main ;denudation processes form loose material.

By their high-altitude position all the types of the region relief are divided into medio-mountain in the interval of altitudes from 1600 to3500m ,and low-mountain -in the interval of altitudes from 1100 to 2200 m. The high-altitude position of one or another relief determines its peculiarities, in particular, intensity, depth and character of erosive dismembering, etc.

There is no Alpine relief with Alpine forms, peculiar to it, in the investigated region.

The climatic factor, which is of great importance in the relief formation, changed essentially in some stages of the relief formation of the investigated region, for certainty. However, We can make very general suppositions about the character of these changes for the region, as a whole.

The characteristic of the distinguished types of relief is sufficiantly minutely given in the legend to the attached "geomorphological map"/fig.43/and is seen in the attached aerophotos/fig.44-53/.

Below we shall deal with some additional data, characterizing different types of the relief, and also some problems on genesis, age and the stages of its formation.

The oldest elements of the relief of the investigated region are the highest parts of the Selsela Koh-i-Band-i-Dawindar and Sel-sela-Band-i-Baba/ the altitudes are within the limits of 2650 and over/,probably, representing remains of highly lifted spaces of pre-Neogene age, relatively slightly broken /A Ia PN/. The sides of valleys and watersheds in these areas are more gentle than on lower bench marks;they are much turfed. These sections are usually surrounded by a lower ar more sharp erosive relief, the age of which can be dated conventionally as Neogene/A Ia N/. Ridgy-hilly old surfaces of flattening of the Neogene age appertain to this relief./D 2a N/. This confirms the age of the old pre-Neogene erosive relief, reflecting, probably, the oldest stage of ascending development of the region and the formation, conditioned by it, of the old mountain rugged country.

By Neogene and in the beginning of the Neogene period /Miocene/ gradual flattening of the country, conditioned,probably, by a relatively stable tectonic state /probably, only some sections experienced inconsiderable uplifts/.Denudation with predomination of surface erosion takes place in this period of time. These processes cause replacement of an old pre-neogene erosive relief by a younger Neogene relief, the basis for which was a denudation submontane plain. Terrigene continental sediments of the Neogene age deposited in some of its sections/ for example, the deposits of the Khassanabad suite/.

In the end of the Neogene-the beginning of the Quaternary period a new manifestation of tectonic movements caused the general uplift of the region. As a result of this, the denudative-accumulative surface, formed in the Neogene, was dismembered along large tectonic ruptures into a series of blocks, which were raised to a different height. Those blocks, which fell behind in their ascending movement, preserved a cover of loose Neogene deposits up to now/ for example, in the region of the northern and southern submountains of the ridge Selsela- Koh-i-Band-i-Baba, in the west of the region,the others-uplifted higher- were nearly completely separated from th The Neogene denudative-accumulative surface /A Ia PN/ is observed as outliers in t axial parts of the ridges Selsela Koh-i-Dawindar and Selsela Koh-i-Band-i-Baba in interval of altitudes 2500-2650m at present. It has either no loose cover / in the

ridge Selsela Koh-i-Band-i-Baba/ or covered with continental marlaceous-loamy or ca areous sediments/ of type of lacustrine limestones/ the Central part of the ridge Se sela Koh-i-Band-i-Baba/.

Beginning from the Lower Quaternary epoch the uplifted sections of the Neogene denudation accumulation surface were subjected to intensive erosive ruggedness and denudation, as a result of which the considerable part of this relief was replaced and continues to be replaced by the erosive steep sloped type of the relief up to now /A Ia Q_{1-4}/. It is clearly seen on the attached aerophotos/ fig 44-45/.

Probably, as a result of tectonic movements, taken place on the verge of the Neogene and Quaternary periods the ridges Selsela Koh-i-Band-i-Baba x/ and Selsela Koh-i-Dawindar became formed as highs fimally, as well as the depression, dividing them, and al depressions south of the ridge Selsela Koh-i-Dawindar and north of the ridge Selsel Koh-i-Band-i-Baba, and the main hydronet was located.

The increased processes of denudation and erosion simultaneously with tectonic differentiation, of the region, continued in this epoch, formed the recent plan of large elements of the relief / the ridges Koh-i-Dawindar and Koh-i-Band-i-Baba, the Karukh depression, finally by the end of the lower Quaternary epoch.

Denudative-erosive tectonic /B Ia/ and structural-denudative /C Ia/ types of th region relief began to form in this epoch.

Activity of the relief formation was rather high, of which sharp predomination of evacuation of fragmental material over the accumulation processes is indicative.

At any rate, we have not found somewhat evident accumulations of the lower Quat nary deposits in the investigated region.

The erosive-tectonic relief, located in the lower Quaternary epoch, continues t develop up to now. Depending on its high-altitude position it is divided into medio-montane and low -mountain.

The medio-montane erosive types of the relief are characterized by considerable cuttings of valleys /up to 800m deep/, which determines their characteristic feature in the first place/fig. 46/. The rest peculiarities of the relief of this category depend on the age and lithology of the rocks wholly, on which they formed. Thus, the lief of the type "A Ia" is characterized by disorderly or dendrite-like branching o valleys , not depending on structural-tectonic peculiarities of this or that section /fig.44/. Only in exceptional cases subordination of valleys to zones of large ruptu

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x/ Probably, the ridge Selsela Koh-i-Band-i-Baba existed in Neogene as an inconside able high. The presence of Neogene terrigene formations /the Khassanabad suite-N hs/ south and north of it points to the above said.

is observed.The most considerable river valleys are ,probably, not superposed/epigen ic/.

Among the relatively young erosive-tectonic relief an erosive relief with "ruined" forms, usually observed in the near-watershed parts of the slopes is distinguished / /A Ib/. Its formation is conditioned by lithological peculiarity of the rocks, on which it is formed,i.e. the presence of massive coarse conglomerates with rare lar pebbles and boulders. The latters protect the sections of the rock on the slopes from erosion, causing their ruggedness as column or column-like formations, resembl ing ruins. These forms are developed not everywhere, but, on the whole, attach pecul rity to this type of the erosive relief.

The erosive relief, different from the before described, formed on porphyry-lik granites /A Ic Q_{I-4}/. Probably, the valleys in plan have a complicatedly -branched form, to a considerable degree subordinate to the prevailing direction of fractures due to the systems of partings/joints/. The sides of valleys and watersheds are ste and rocky, often blocked up with rock waste materials/fig. 45/.

In the middle Quaternary epoch considerable moistening and general change of cl ate took place;they brought to appearance of snow caps in most uplifted sections of mountains and to the formation of rare glaciers of corrie type, the traces of which are fixed by us in the ridge Selsela Koh-i-Band-i-Baba as a small-hummocky-sunk moraine relief, partly overlain by old colluvium, in relict corrie circuses at an altitude of 2400m. These corries are partly cut in the old Neogene denudation surface;at the sam time they are located at an altitude of I00-I50m above the recent cutting of valleys

The increased denudative-erosive processes brought to the final formation of th denudative-erosive-tectonic /B Ia/ and structural denudative /C Ia C Ib/ types of r relief in the most raised sections of the region, composed of Cretaceous-Paleogene d osits at this time/fig.47-48/, and also to deepening of erosive cuttings in the sec- tions with the erosive-tectonic relief, located in the lower Quaternary epoch.

Still more considerable subsidence of the Karukh depression took place in the same epoch, probably, as a result of which it turned into a closed basin.A great quantity of loose products of denudation evacuated in the submontane zones at this time, mainly beyond the limits of the region, and also in the Karukh depression and in a smaller depression in the region of Madjed-i- Chob-iv, where rather thick accum lation of loose deposits took place at a rather stable tectonic regime.

Material deposited as vast proluvial-alluvial debris cones in the submontane zone and fed a fresh water lacustrine basin, appeared here for a short period in the same epoch. The deposits of lacustrine and proluvial-alluvial types are closely con- nected with each other and practically are not divided in the sequences. Proluvial d posits with their peculiar flattened relief /D Ib $Q_2/_3$ were superposed on the prolu

ial-lacustrine plain /D Ic $Q_2/_3$ in the submontane zone only in the final stage of fill ing the basin, when proluvial processes ceased to prevail, and the lacustrine basin did not exist practically. Filling of the depressions with proluvial-alluvial-lacustri ine deposits brought to the formation of the plain accumulative relief/fig.49-50/.

Under the conditions of progressive aridization of the climate the formation of "cal careous crusts", developed on different rocks, including proluvial-alluvial-lacustrine and proluvial deposits, took place in the same epoch.

This period completed practically the formation of the relief in general plan, in cluding the development of large river nets, transporting fragmental material in depre sions.

In the end of the middle Quaternary epoch shifts along rupture dislocations, having located, probably, before, and having a sublatitudinal strike, took place. These shifts covered proluvial-alluvial-lacustrine depodits and created conditions for dismemberin this complex into separate raised sections/ for example, north of the settlement Dalant fig.5I/.

Essential change in the climate in the beginning of the upper Quaternary epoch brought to sharp reduction of denudative-erosive processes. At this time loess-accumu- lation, connected with talus-eolian processes, develop intensively. Loesses especially intensively deposited on the north-western slopes of mountains, for example, in the south-eastern corner of the Karukh depression and on the adjacent [illegible] versants of the Selsela-Koh-i-Davindar, and also on the northern versant of the Selsela Koh-i-Band i-Baba. In this stage of development loesses overlie the erosive relief, created befor and flatten its contrasts. The outliers of the former loess cover are seen very often on the watersheds at present, which points to its eolian origin. At the same time lo- esses turn into loess-like loams and contain admixture of coarse-terrigene material, w which points to the development of the talus process, accompanying eolian accumulation in subsided sections. Probably, the landscape of this period had a mountain-stepped character and was characetrized by dryness of the climate.

In the middle of the upper Quaternary epoch evident uplifts and moistening of the climate took place, which brought tp intensification of erosive processes.

Further cutting of riverbeds of large water flows took place due to it. The Rod-i Karukh river, for example, cut proluvial-alluvial-lacustrine deposits down a depth of 30-35m its right tributary -Rod-i-Darakht-i-Tut -at a depth of not less than 20-25m, e etc. Twofold filling of valley cuttings with proluvial-alluvial material and the furth er cutting brought to the formation of the middle complex of terrace benches, 25-20 an I6-I2m high above the recent water line. The middle complex of the terraces/DIbQ. is spread rather limitedly in the investigated region and is observed in the valleys of the large rivers, such as Rod-i-Karukh, Rod-i-Darakht-i-Tut and some others.

Apparently, at this time/ the middle of the upper Quaternary epoch/ a net of

small valleys, conditioned the formation of the hilly-ridgy relief in the northern submountain region of the ridge Selsela Koh-i-Band-i-Baba/A Ic Q_3/ and erosive-tectonic low mountain relief of the type "Bad land" in the south-western part of the territory, was located.

Originally the hilly-ridgy relief was located on uniform loesses rocks, in the s area, subjected to inconsiderable uplift. As a result of this uplift a loess surface inclined to north, formed . It was dismembered by meridional valleys, directed subparallelly, of temporary water flows /fig.52/.At further deepening and cutting in the rocks,underlying the loesses/effusions, clays, sandstones, conglomerates,and other of eocene and neogene age/the part of these valleys acquired an epigenetic characters,preserving its original direction up to now/ for example, the valleys of the river Darya-i-Khwaja Shakhab, Joy-i-Karez-Chashma,etc/.

The formation of the relief of the type"bad Land" is connected with sharp, but negligible tectonic uplift and erosion manifestation.Originally the river valleys, contained here, were of the epigenetic character, but then lost it partly and were subordinate to structural-lithological factors to a certain degree in their development.In connection with this they acquired a complex branching character-they either cut the inclined rock beds, or follow their strike/fig.53/.

Simultaneously with the described processes intensive mounting of the considerable and most uplifted part of the territory from the loess cover begins and dismembering of loesses and loess-like loams and location of the ridgy-hilly relief/D 2a/ -in less raised sections.

In the process of the transformation of the loess cover suffosion processes as subsidence cones, slightly developed and locally manifested, began to develop. These processes manifest slightly at present as well.

In the end of the upper Quaternary-the beginning of the recent epochs negligible tectonic shifts along the ruptures of the sublatitudinal direction, took place. Tectonic scarps of this age, strongly pronounced in the recent relief, are seen in a row of places and reach 30-50m high. These scarps are traced along the strike for 5-10km and sometimes -more km. They dislocate loesses and loess-like loams of the upper Quaternary age, though there are no distinct benches in these cases, which is explained by easy destruction of these rocks and levelling activity of talus processes.

Probably, the formation of antecedent sections of the valleys,for example, the Darya-i-Kushk down the settlement Darra-i-Jowal,Darya-i-Gala-Chagar in its lower course,etc.should be connected with rupture dislocations of this age.The antecedent behavior of some sections of the valleys is not connected with displacement of blocks along the ruptures and is conditioned, apparently, by the newest gentle dislocations, the character of which is not clear up to now/ the valley of the Darya-i-Kushk down to the settlement of Tagau Rabat, the Rod-i-Maluma down the settlement of Palawana/.

All those processes, which manifested in the second half of the upper Quater system, continue to develop in the Recent Epoch.A considerable part of the territ becomes free of the loess- cover, the ridgy-[illegible]-undulating and undule ridgy types of relief continue to form,and the erosive relief deepens. At the time deepening of river valleys in the whole studied territory and the formation benches of the complex of low alluvial-accumulative terraces, 8-6 4-I5 m high, and the recent riverbed /D I/take place.These benches are more widely spread ,than the benches of the middle complex. They reflect pulsating character of tectonic mo ments in this period,and correspond to twofold cutting of riverbeds and threefold filling of the valleys with proluvial-alluvial material. Filling of the recent ri beds with fragmental material takes place in the present time.The valleys of short rivers and their tributaries are gradually filled with proluvium, carried by la eral tributaries, talus of the slopes, blocks and become turfed in a row of cases in spite of the negligible width of bottoms /I0-15 m/ and steepness of the slopes with rocky outcrops and [illegible] hillside wastes. All this points to weakening erosive processes at present due to inadequacy of precipitations and negligibili of flows strength, which cannot carry fragmental material, accumulating in riverbe The above mentioned concerns shallow tributaries or those which are filled with wa er periodically of the Rod-i-Darakht-i-Tut and Rod-i-Karukh,etc. The lateral tributa ies have a duspended character of valleys.

At last, it is necessary to say some words about the activity of man, creat ing some peculiarities in the recent relief of the region. Terraced slopes, tilled for fields with a system of irrigation ditches, are made by man in the areas, fit to agriculture /the region of the settlement Karukh, in the valley of the Darya-i-Kushk and in other places/. Taking water for watering fields makes rivers shallow, especially in their middle and lower courses, which also favours gradual accumula tion of loose material in riverbeds.

Thus, The following stages of the relief formation can be distinguished in the investigated territory:

I. In the end of Eocene-the beginning of Oligocene intensive tectonic movements caused uplift of the region and the formation of the mountain country, probably, wit a sublatitudinal direction of ridges and intermountane valleys, similar to the recent one.The mountains of this age with the erosion subdued relief are preserved in smal sections in the axial parts of the recent ridges Selsela-Koh-i-Dawindar ,Selsela Koh i-Band-i-Baba as relics of the pre-Neogene relief.

2. In Neogene, a considerable part of mountains was turned into a plain, on som part of which loose terrigene deposits accumulated due to the denudative-erosive pro esses, intensively manifested.

3.

3. At the end of Neogene-beginning of the Quaternary period tectonic movements caused new uplifts and sharp tectonic differentiation. The mountain ridges Selsela Koh-i- Dawindar, Selsela Koh-i-Band-i-Baba, the depression, dividing them, and the depressions, located south and north of them, outlined finally at this time. The main river net of the region superposed at this time, its sharp erosive [illegible] ruggedness and the formation of structural-denudative types of the relief begin.

4. In the middle Quaternary epoch, as a result of the continueing ascending tectonic movements and change in the climate, snow caps and corrie glaciers appeared on the mountain tops. At this time the Karykh depression turns into an accumulative-tectonic basin. The second basin of less dimensions outlines in the region of Madjedoi- Chobi. Rather thick proluvial-alluvial-lacustrine deposits begin to accumulate in these basins. Substitution of old denudative surfaces with erosive land forms reaches its maximum at this time. By the end of the epoch the outlines of the regions of development of erosive land forms are near to the recent ones.

5. In the first half of the upper Quaternary epoch denudative-erosive processes sharply reduce its intensity. Under the conditions of progressing aridization of the climate talus-eolian deposits/ loesses and loess-like loams/deposit as a mantle, which is widelt spread and leveled the steep erosive relief, formed before. In the second half of the upper Quaternary epoch in connection with moistening of the climate and new tectonic shifts denudative-erosive processes increase again, as a result of which mounting of the surface from loesses and [illegible] in the first place, of the most raised sections and steep-sloped areas manifested everywhere, the erosive net increased, river valleys deepened in two times and were filled with loose deposits, which caused the formation of the middlw complex of erosive-accumulative terraces. In the north of the region ruggedness of the raised talus-eolian loess plain with tectonic movements with the formation of the dulating-ridgy relief begins. The relief of the type "bad Land" forms in the south-west of the region.

6. In the recent epoch the formation of the complex of low terraces and filling of the riverbeds with recent proluvial-alluvial deposits takes place, ruggedness and denudation of the relief, formed in the middle- upper Quaternary epochs continue. Effectiveness of the erosive ruggedness and denudation reduces from the beginning of the recent epoch to the present time, corresponding, probably, to increasing aridization of the climate.

CHAPTER VII. MINERALS.

During the geological- survey works great attention was drawn to search for minerals and, in the first place, for coal.

Manifestations and deposits of coal were seen before in the investigated area. It was the grounds for its systematic studying with the purpose of coal presence evaluation, the results of which are given below.

As to other minerals the investigated region has limited perspectives.Cement raw materials-limestones and marls are the most important ones.Iron ore manifestations can be of interest for the local industry, but it is necessary to carry out special works for their evaluation.Phosphorite manifestations, found for the first time, have very low content of P_2O_5, however, they have a prospecting significance.The manifestations of copper ores , though they are numerous in the region, are negligible in scales and are of no practical interest. Besides,there are brick earths and pebbl gravelly formations in the region.

The description of manifestations and deposits, exposed in the process of the works and known before, are given below.

COAL PRESENCE.

As a result of the carried out investigations the determination of the coal presence to two rock complexes of different ages is ascertained:lower Carboniferous and middle Jurassic. Both of them are rather limitedly spread in the studied region.The summary area of the outcrops of coal-bearing deposits is only 60 sq.km or about 2% of the area of the whole studied territory. If to take a comparatively small thickness of coal seams and their interrupted lens-like character, peculiar for all the coal manifestations without exception,both-Carboniferous and Jurassic ages,into consideration, the conslusion of low coal presence of the studied area as a whole and complete absence of any perspectives concerning finding new coal manifestations or coal deposits should be considered right. Further studying and conducting prospecting works in the known and described below coal-bearing sections can make the problem of the coal reserves in the investigated region clear.The corresponding recommendations are given below.

Three deposits of coal:Chartaq, Pahlawanha and Madjed-i-Chob-i- were mentioned in different report and literature data concerning the investigated region.Other coal manifestations had been not found in the investigated territory before, and were not exposed by us during prospecting survey works.The mentioned coal manifestations and the areas, adjacent to them, were studied in details.As a result of this investigation it was ascertained that the coal manifestations Pahlawanha and Chartaq are confined to the deposits of the Carboniferous age, that of Madjed-i-Chob-i- to the deposits of the middle Jurassic age. This determines mainly quite different structural and qualitative peculiarities of these coal manifestations.

The Pahlawanha coal manifestation /I-IV[x]/ is situated east of Herat for 75km, in the lower course of the stream Rod-i-Maluma. The section coordinates: $34^{\circ}24'50''$ - $34^{\circ}26'8''$ at North Latitude, $62^{\circ}46'45''$-$62^{\circ}48'15''$ at Eastern longitude. There is a bend of the road from the main road, connecting Herat with Qalai-Nau to the settlement Maluma, up to which an earth road lies with the extention of 4 km, II km east of the settlement Karukh. There are I5 km between the settlement Maluma and the coal manifestation, from which only I0 km can be covered in a car by a field road up to the steep slope into the valley of the Rod-i-Maluma. The rest section of the road, 5 km long, lies along the steep slope and then along the valley bottom and fit only for pack-riding trandport.

In 1958 the coal manifestation was investigated by the American geologist-Paul C.Hammer, who gave it negative evaluation, because of its insignificance. No output works were carried out in the coal manifestation.

The Pahlawanha coal manifestation /fig.54/ is situated in the axial part of a small anticline, sublatitudinal in strike. Its core is composed of dislocated Carboniferbus deposits, and the wings- of the Permian deposits. The first are dismembered into two suites: lower-Pahlawanha and upper-Sangizard suites.

The Palawan suite is of lower and ,probably, partly of middle-Carboniferous age. Its upper coal-bearing part, composed of interbedding of argillites, aleurites and sandstones with frequent interbeds of limestones, conglomerates and gritstones crops out in the region of the coal manifestation. Partings of coaly argillites and coals ,3-20 cm thick, are seen in the sequence.

The lens-like coal seams of minable thickness are confined to three strata, divided by small bands of coal-free rocks.

The most upper one is 20-25 m down the suite roof, the middle- 65-70m, the lower 85-II0 m/ fig. 54/. Coal seams appear in these strata as lenses, 100-300m in extent. They pinch out along the strike, fully replaced by coaly argillites. The upper and middle coal seams are from I.0 to 2.5m in thickness and are of simple structure. The lower one is the most miserable. Only in one place a thickness of 0.8m was observed and in this case it contained a great quantity of interbeds of coaly argillite. This coal seam is of no practical interest, probably. The apparent thickness of the Palawan suite in the region of the coal manifestation is about I50 m.

The Palawan suite is conformably overlain by the Sangizard suite, which is of the middle Carboniferous age. It is represented by 300-400m strata of interbedding l

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[x]/ Coal manifestations and manifestations of other minerals are marked with Roman numerals in the attached map of minerals.

limestones, calcareous sandstones and thin argillites.

The Permian deposits overlie the rocks of the Palawan suite with sharp erosion and unconformity.

As it was mentioned above, the Coal deposits are dislocated discordantly with the Permian deposits.The Palawan and Sangizard suites, outcropping in the core of th anticline, composed of Permian rocks, form a synclinal fold, slightly overturned to south, in the region of the coal manifestation.Its northern wing is steep/ dip angle 60-80° up to vertical/ ,and the southern one is gentle. It is composed of a row of small folding structures and is broken with a rupture from the south. The northern wing [illegible] /is lowered.

Four sections are distinguished in the region of the coal manifestation: I.II. III and IV.

Section I is situated 1.2 km north of the settlement Pahlawanha. A coal seam is observed in the right side of the Rod-i- Maluma valley here;its south-western end is 20 m and the north-eastern one -200 m up the valley bottom.The seam is confined to the upper coal-bearing stratum and is 20-25 m down the foot of the Sangizard suite. It lies in the northern wing of the synclinal fold, mentioned before and composed of the deposits of the Palawan suite. Its dip azimuth is 140°, angle-70-80°.

The structure of the coal seam is the following/upwards/:

I.Sandstones, gray, brownish-gray, fine-grained, polymictic	0.4m
2.Argillites, gray, poorly aleuritic, highly crumpled	0.2 m
3. Coal,crushed, with numerous gliding planes, with thin /1-8cm/ interbeds and argillite lenses / samples 252I-3 and -3[a]/	I.3 m
4. Argillites, dark gray, coaly, with interbeds /1-5 mm/of coal	0.2 m
5. Aleurolites,greenish-gray, brownish-gray	0.8 m

The coal seam /Fig. 55/ is traced along the strike for 350 m.Further it is facially replaced by coaly argillites. Its thickness ranges between I m and 2 m, which is ,probably, explained not only by the originally lens-like structure ,but also by the following tectonicextrusion.

Section II is located 1-1.3 km north-east of the settlement Pahlawanha. Here two lens-like coal seams / northern and southern/, also confined to the upper level are observed in the right side of the Rod-i-Maluma valley, 100-200 m above water line/fig. 54/. They are 20-25 m down the foot of the Sangizard suite, one is the continuation of the other. Coal seams are developed on the southern wing of the synclinal fold, composed of the deposits of the Palawan suite. This wing is complicated by two small anticlines and synclines, adjacent to them.The coal seams are traced along western centroclinal closings of synclines. In the northern wings they lie steeply / dip angle up to 60°/, and in the southern ones- gently/ dip angle-10-30°,

The northern coal seam has the following structure /upwards/:

1. Sandstones, gray, fine-grained, polymictic 0.5 m
2. Coal, crushed, highly crumpled, with numerous gliding planes, with small interbeds and lenses /5-7 cm/ of coaly argillites and aleurolites /samples-2576-2 and -2[a]/ 2.05 m
3. Aleurolites, gray, greenish-gray, thin-laminated, with interbeds /5-10cm/ of fine-grained sandstones 0.4 m

The described coal seam is traced along the strike for 250 m. Its thickness ranges between 0.8 and 2.05 m.

The "southern" coal seam has the following structure/ upwards/:

1. Thin interbedding/2-7cm/ of argillites, gray, gray-green and sandstones gray, fine-grained, polymictic 0.5 m
2. Argillites, gray, dark gray 0.5 m
3. Coal, crushed, with numerous gliding planes, with interbeds and lenses of argillites /samples 3505-3 and -3[a]/ 1.6 m

Thick talus is over.

The "southern" coal seam is traced along the strike for 300 m. Its thickness ra ranges between 0.7 and 1.6 m.

Thus, both seams are characterized by non-persistent thickness, which is, probably, explained also by their lens-like character and tectonic extrusion.

Section III is located 1.7-1,9 km east-north-east of the settlement Pahlawanha The coal seam is traced here in the right valley side of the Rod-i-Maluma, 40-80 m above water line in the stream. It is confined to the middle coal-bearing stratum. The deposits of the Palawan suite form a small anticline here, the upper bend of which plunges in a south-western direction. The coal seam is traced in its north-western wing. It lies dip azimuth-350°, angle -40-55°.

Due to pericliral closing of anticline, its bend is seen south- west. The structure of the coal seam is the following/upwards/:

1. Sandstones, gray, fine-grained, polymictic 2.0 m
2. Coal, crushed, with numerous gliding planes /sample 2519-16/ 0.6 m
3. Argillites, gray, dark gray with thin partings of coal/1-2cm/ highly crumpled 0.15 m
4. Coal, crushed with numerous gliding planes, crumpled, with lens-like interbeds /1-5 cm/ of aleurolite, argillaceous and coaly argillite / sample 2519-14/ 1.0 m
5. Sandstones, gray, greenish-gray, fine-grained, polymictic 0.25 m
6. Coal, highly crumpled, crushed, with numerous gliding planes, with interbeds and lenses /1-5 cm/ of aleurolite, gray, green-gray. Gypsum interbeds are near the roof / sample 2519-12/ 0.35 m

7. Sandstones, gray, grayish-gray, fine-grained, polymictic I.5 m

Along the strike the coal seam is traced for 350 m. Its thickness is not persis ent and ranges between I and 2.5 m. It is explained not only by primary conditions of accumulation, but also by tectonic extrusion.

Section IV is located 3 km east of the settlement Pahlawanha in the right sid of the Rod-i-Maluma stream valley, 60-80 m up its bottom. A coal seam, confined to the middle coal-bearing stratum and having a north-eastern strike and vertical dip, crops out among the deposits of the Palawan suite in exceptionally complicated tecton conditions.. The structure of the coal seam /fig. 54/ is the following /upwards/:

I. Argillites, dark gray, aleuritic, crumpled, with gliding planes and lens-like thin interbeds /3 cm/ of fine-grained sandstones I.3 m

2. Coal, crushed, crumpled, with numerous gliding planes/sample 3619/ I-I.2 m

3. Argillites, dark gray, coaly 0.4 m

4. Argillites, dark gray, greenish gray, crumpled, with gliding planes I.0 m

The coal seam crops out only in the bottom of a small scour. Along the strike it is traced for 20-30 m and is hidden under thick talus.

Petrographical and technical studying / moisture-W^c, ash- A^c and volatile-V^r/ of the Palawan coals was made by M.A.Marshanskaja/Judina/ and L.M.Andreeva.The carr ed out investigations point to the very uniform composition of the coals of the Pala wan coal manifestation.

In the macroscopical description a considerable content of ash coals and coaly rocks is mentioned in the samples/50-100%/. Only two samples contain about 50% of half-glossy finely-striated, rather ash coal. The sum of mineral impurities/ table I, changes from 27% to 44% according to weighted average values. Argillaceous minerals are contained in a quantity of 23-36%, quartz and chalcedone-3-7%, iron hydroxides-I% ,inclusive. Argillaceous minerals fill fractures in the coal and are in the struc-ture of coal. Sometimes the fractures are filled with siderite. The upper part of the seam of the third section is especially rich in siderite. Its content reaches 5.6% here of the sample volume. A small quantity of pyrite, partly oxidized up to iron hyd-roxides, is seen in the sample from the second section.

The mineral composition of coals /table No.I/ is characterized by high content of the components of the group of vitrinite /V/-87-95%. The components of the group of fusinite/F/ are contained in a negligible amount-4-13%.Poorly oxidized compon-ents of the group of semi-vitrinite /SV/ are in a small quantity. Probably, they are badly distinguished because of high metamorphism and ash content of the coals.

The calculation ash content of the coals of Pahlawahna changes from 31% to 59%. It is 40% in all the samples at an average. The calculation specific gravities

Table I/

LEVELS	SECTIONS	SAMPLE No	Sampled thickness	Oxidation degree	Mineral impurities						Mineral composition			
					Org. mass	Pyrite	Calcite	Argillaceous mass	Quartz	Iron hydroxides	Siderite	V	SV	L	ok
Upper	I				71			23	4	1	1	89		11	
	Г	Г-2521-3а	0,6	82	47.1			45.6	6.5	0.8		94		6.0	
		Г-2521-3	0.7	63	64.2			27.0	8.1	0.7		91.5		8.5	
	Weighted average of the bed:				56			36	7	1		93		7	
Upper	II	Г-2576-2	1,05	99	65,4			29,3	3,3	2		91,5	99	7.6	
	"Northern bed"	Г-2576-2а	1	94	80,9			15,2	3,3		0,6	91,9	1.1	7.0	
	Weighted average of the bed:				73.0			23	3	1		92	1	7	
Upper	II	Г-3505-3	0,8	93	72.3			22.4	4.7	0.6		94.5	14	4.1	
	"Southern bed"	Г-3505-3а	0.8	92	68.3			28.3	2.7	0.7		95.4		4.6	
	Weighted average of the bed:				70			25	4	1		95	1	4	
Middle	III	Г-2519-12	0.35	95	46.0			44.4		4.0	5.6	90		10	
		Г-2519-14	1.00	92	75.6			19.2	5.2			87.7		12,8	
		Г-2519-16	0.60	95	78.0			15.7	5.5	0.8		90.7	1,8	8.7	
	Weighted average of the bed				70			25	4	1		95	1	4	
Middle	IV	Г-3519-3	1.2	88	59.51			34.4	455	0.5		92.5		7.5	

Table No.2.

LEVELS	SECTIONS	SAMPLE No	Calculation values Specific gravity	Ash content	Enrichment Concentrate i.m. Yeild	Ash content	Altogether coal concentrate yeild	Enrichment degree	Sulphurousness Altogether coal	Concentrate
Upper	I	Γ-2521-3a			21	6	0			
		Γ-2521-3			39	5	0	v. difficult Very difficult		
Upper	II "Northern bed"	Γ-2576-2	1.71	41.0						
Upper	II "Southern bed"	Γ-3505-3	1.63	34.6						
		Γ-3505-3a								
Middle	III	Γ-2519-12	2.00	55.3						
		Γ-2519-14	1.59	31.4						
		Γ-2519-16								
Middle	IV	Γ-3519-3			35	5	0	Very difficult	2.2	0.2

range within the limits of I.59-2.00 according to the samples.

See table No.I.

Coal enrichment /table No.2/ is very difficult. Altogether/raw/ coal, crushed coal do not form concentrates.

In table No.2 only the calculation values, the ash content by which differs from the chemical definite one up to ±5%, are given. Such a difference in ash content guarantees the determination of the specific gravity by petrographic data with accuracy ± 0.05%.

See table No.2.

According to the technical analysis /table No.3/ the coals are characterized by high ash content/A^c-30.0-74.18/and sharply heightened moisture /W^a -2.75-10.41/. The latter points to their high oxidation.

Table No.3.

Levels	Sections	Samples Nos	A^a	A^c	Characteristic of coke button
Upper	I	2521-3a	3.80	71.74	74.18	Powder-like
		2521-3	3.68	60.44	62.51	" "
Upper	II	2576-2	10.41	41.83	46.40	" "
	"Northern seam"	2576-2a	10.30	29.97	33.41	" "
Upper	II	3505-3	7.63	32.82	35.51	" "
	"Southern seam"	3505-3a	7.45	41.45	44.81	" "
Middle	III	2519-12	6.64	47.56	50.94	" "
		2519-14	9.39	27.12	30.00	" "
		2519-16	8.30	41.84	45.82	" "
Middle	IV	3519-3	2.75	55.00	56.70	" "

The metamorphism of the described coals /table No.4/ is within the limits of the group of lean coals and changes from T-low-metamorphosed/ section II ,The "southern seam/ up to T-high-metamorphosed /section II, the "northern" seam/.

Consequently, one can expect volatile show /V/ for the coals of Pahlawahna within the limits of 6-10%.

Table No.4

Table No. 5

Sample section No	Sample No	Sampled thickness	Oxidation degree %	Mineral impurities						Mineral composition in %				
				Org. mass	Pyrite	Calcite	Argillaceous minerals	Quartz	Iron hydroxides	Siderite	V	SV	F	L	ok
6	Г-437-3	1,10	17	85.7	2.3	-	10.3	1.7		-	79.8	8.5	11.7	-	18
	Г-437-2	0,60	7	69.5	1.5	-	23.9	5.1	-	-	77.7	14.4	9.3	0.6	19
	Г-437-1	0.80	13	80.1	4.4	-	13.3	2.2	-	-	89.2	7.5	2.8	0.6	8
	Weighted average of the bed:		8	80	3	-	14	3	-	-	82	9	9		16
	Г-438-2	0.60	6	95.0	4.0	-	1.0	-	-	-	75.2	17.8	4.0	3.0	17
14	Г-438-1	0.60	9	96.3	3.2	0.5	-	-	-	-	74.0	19.0	7.0	-	21
	Weighted average of the bed:			96	4			-	-	-	75	18	5	2	19

Point No.6 contains mineral impurities in coal from I4 to 30%.

point No.I4 –4–5%.

Table No. 6.

Point No	Sample No	Calculation Values		Enrichment				Sulphurousness	
		Specific gravity	Ash content	Concentrate -1.5 mm Yeild	Ash content	Altogether coal / Concentrate yeild	Enrichment degree	Altogether coal	Concentrate
6	T-437-3	-	-	58	7	0	Difficult	I.0	0.3
	T-437-2	I.67	37.5	46	6	0	Very difficult	2.0	2.I
	T-437-I	I.63	27.3	64	7	0	Difficult	2.3	0.6
I4	T-438-2	I.47	I0.6	85	5	60	Middle	3.6	I.I
	T-438-I	I.44	8.5	89	4	68	Middle	3 .3	2.9

Table No.4

Levels	Sections	Samples Nos	Degree of metamorphism	Remarks
Upper	II "Northern seam"	T-2576-2	VI_2-VI_3	Lean, high-metamorphosed.
Upper	II "Southern seam"	T-3505-3	VI_1	Lean, low-metamorphosed.
Middle	III	T-2519-I4	VI_2	Lean, medium-metamorphosed.

Calorific capacity of the coals for ash-free combustable mass in the bomb /Q^r / can be within the limits of 8300-8500cal.

On the grounds of the cited above, one can draw the following conclusions.

The Pahlawanha coal manifestation is confined to the complicatedly dislocated deposits of the lower- middle Carbonifeous age.

The coal seams are lens-like in form, scanty, not extensive, are highly crumpled They are characterized by changeable thickness, conditioned not only by its primary alteration, but also by tectonic extrusion.

According to the results of petrographic and technical analyses the coals of Pahlawanha appertain to the brand "T" / lean/, are of high degree of metamorphism, low volatile show and negligible ash content, due to which they are of no interest for industry.

The Pahlawanha coal manifestation is not worth of further works due to its insignificance and difficult transport economical conditions.

(2) The Charteq coal manifestation, by the data of P.Hammer (1958), is located approximately I8 km north of the settlement Ferrah[x], from which I2 km can be covered in a car and 6 km -by horse or on foot The coordinates of the coal manifestation are 34°32'-62°35'. The given coordinates form a point within proluvial-alluvial -lacustrine deposits, 6 km north of the settlement Karukh, where there are no bedrock outcrops. Probably, the coordinates are erroneous.

In the process of geological mapping an outcrop of middle Carboniferous deposit /Sangizard suite/ was observed about I8 km north of the settlement Karukh, i.e. just there, where P.Hammer wrote! the coordinates of this section are 62°38'50'' and 34°36'I5'' N.L. The sequence is represented by alternation of gray platy crinoidal limestones, sandstones with quartz pebble and gritstone lenses and black coaly argillites The limestones prevail; beds of black coaly argillites are seldom seen as well as

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x/ Apparently the changed name of the settlement Karukh.

contain thin lenses/I-5mm/ of dull coal.The rocks lie with a dip azimuth I50-I80°, at an angle from 30 to 60°.

There are no evident coal manifestations in this section.

Another place in the same region was shown to us by local hunters. It is located in the upper part of the left component of the Darra-i-Chartaq river on the southern slope of the mountains Selsela Koh-i-Band-i-Baba. The coordinates of this point are 62°39' E.L. and 34°37' N.L. Middle Carboniferous deposits / Sangizard suite/, represented by black, sometimes greenish, poorly micaceous argillaceous shhles with rare interbeds of sandstones and gray calcitized crinoidal limestones with fauna of the Middle Carboniferous, crop out in the this section also. Carboniferous deposits compose a small tectonic block /Ix3 km/ in the zone of the low-angle overthrust of Permian deposits on Eocene ones/ Alaian stage/. The dip azimuth of Carboniferous deposits is I80-I70°, the angle -from 50 to 90°.

Near the overthrust surface black argillite shales are intensively ground up to flour, dirtying hands, are black and taken for coal smut by local population.The investigation of this region showed that there are no coal manifestations here.

Thus, the Chartaq coal manifestation, ascertained before, does not exist in fact and that is why it is not shown in the attached mineral resources map.The area of development of middle Carboniferous deposits is inconsiderable and is situated in difficult transport-economical conditions, which makes further prospecting works here inexpedient.

(3) The Madied-i-Chob-i- coal deposit /V-VII/ is located in the upper course of the Rod-i-Karukh,I08 km east of Herat, I km up the course of the settlement Hamam at an altitude of 2300 m.

The deposits is connected with Herat by an earth road, fit to traffic of motor transport during the whole year.

In I945 The Ministry of Exploitation of Afghanistan organized domestic output of coal for the first time .

In I94I the deposit was visited by Mr. Guliam Mohammad from the Department of public works.

In I950 the deposit was investigated by the Geological Management of Afghanistan with the purpose of its evaluation and determination of perspectives. The works were directed by D.Lemmon and Abdul Latif Khan. Mr. D'Lemmon gave right and objective evaluation of this deposit, coinciding with ours in general outline.

At present the deposit is inconsiderably exploited/ about I ton of coal is putpu every 24 hours/.

Within the limits of the deposit coal seams are traced with intervals for 3km in a north-western direction in the right side of the Rod-i-Karukh valley and its left

tributaries.Coal seams are stripped only in the sides of steep cuttings of valleys, are completely hidden under thick Quaternary deposits on the watersheds and in the valleys themselves.

Output of coal was concentrated in the most exposed sections and is carried out now. There are three such sections along the band of coal-bearing deposits from its south-eastern end to the north-western one:South-western, central and North-eastern. The distances between the sections are I-I.2 km.

For the section of the deposit we compiled a geological sketch map on a scale of I-25000 / see annexes/.

The Masdjed-i-Chob-i deposit is confined to the strata of the sediments of the Middle Jurassic age, composed mainly of aleurolites, compact, sometimes containing carbonificated plant dendrite, gray argillites, sometimes they are coaly, black with thin lenses / from parts of mm to 2-3 cm and sometimes up to I0-I5 cm/ of glossy coal and sandstones, light gray, compact, quartzy, sometimes with impurity of grains of gritstone material. Aleurolites prevail; sandstones are in a less quantity.The total thickness of the Middle Jurassic deposits in the deposit region changes from 73.00 to 97,00 m.

The above enumerated rocks have rhythmical alternation, but the thickness of the components of every rhythm and the rhythms themselves have no constant values and change essentially even at comparatively short distances. It is quite clear from the comparison of the sequences of the Central and North-western sections of the the deposit,given in the section"Stratigraphy" in fig. I0, and is conditioned in general, by the lens-like character of rock occurrence in the sequence.

The Middle Jurassic deposits in the deposit region overlie the deposits of the lower Triassic age/ sandstones, aleurolites, tufogenic sandstones, tuffs and lavas/ with sharp angular disconformity. the latters lie mainly monoclinally with dip to north-east or north-north-east at angles from 20- to 45° , locally they are crumpled into folds of the north-eastern strike and are complicated with rupture dislocations.

The Middle Jurassic deposits have an evident monoclinal dip to north:dip azimuth 0-350°, angle I3-I5°.Against the background of monoclinal occurrence very gentle anticlinal and synclinal bends with sublatitudinal strike of axes are outlined/ see the geological sketch map of the deposit region and sequences to it/.

The deposits of the middle Jurassic age are overlain by conglomerates and limestones of the Albian stage with weakly expressed angular disconformity. Due to this the sequence of the middle Jurassic deposits increases in thickness in a northern direction/ up to 30 m for I km/, over-constructed with higher strata.

Besides, the middle Jurassic deposits together with the Triassic deposits, underlying them, are broken with rupture dislocations, which are more often of the upthrow fault character of the sublatitudinal strike.

The upthrow fault surfaces are usually inclined to south at angles 60-80°. The relative amplitude of displacement of wings changes from parts to the first hundreds of metres. These dislocations displace the strata of middle Jurassic deposits, but do not affect the albian and younger sediments, overlying them. Near these ruptures the middle Jurassic deposits often have plication or hitched up in the direction of the upthrown wing /dip angles reach 30-35°/, are broken by inconsiderable ruptures of the north-eastern or north-western strike with the amplitudes of wing shifts within the limits of the first metres.

Minable coal seams[x/] are present in sequences in a quantity from 1 to 2. They have inpersistent thickness and lens-like character of occurrence as the rocks, containing them. The coal seams are confined to thicker rhythms with heightened thickness.

Two coal seams from I.00 to 2.6 m are fixed in the sequences of the deposit: lower-lying 2I-22 m from the basement, and upper-one, lying 40 m from the overlying Albian conglomerates. The rock band between these two seams has a thickness from 37 to 44 m in different sections.

The first seam of them / lower/ is exploited in south-eastern and central sections. The second one/ upper/ is stripped in the north-western section. Besides these two seams and interbeds, from 305 to I0-I5 and more seldom [illegible] up to 25 cm are seen in the sequence. Sometimes they form a frequent interbedding with argillites and aleurolites /"puff-pastry"/. Such seams of complex structure contain up to 40-50% of coal with the total thickness from 0.8 to 2.00 m. They were observed in the sequences of the Central and North-western sections and should be taken into consideration while studying and prospecting the deposit, because they can give minable coal in case of sufficient persistence.

The description of some sections of the deposit is given below/ see the geological sketch map/.

South-eastern section /y/ is located in the upper part of the Rod-i-Karukh valley, on its right side/fig.56/. The only adit-like working, complicatedly branching at depth is located here, 5 km above water line of the stream/fig. 57/. The coal seam is stripped for 42 m along the dip and for 43 m along the strike.

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x/ A thickness from I m and more is taken as workable thickness of coal seams.

The coal seam lies in the lower part of the middle Jurassic sequence /"lower seam"/ and has a changeable azimuth of dip from eastern/100-95°/ to southern/150-160°/ and dip angle from 15-25° to 35°. Apparently, such inpersistence of the azimuth and dip angle is explained by nearness of a large rupture dislocation, passing in a latitudinal direction, 100 m south of the working. This rupture limits the distribution of the band of the middle Jurassic coal -bearing deposits from south.

The coal seam thickness ranges from 1.35 to 2.6 m/ incomplete/ by the measurements in the underground working; average-not less than 2.00 m. The structure of the coal seam is shown in fig. 57. Sometimes lenses of coaly argillite, 1-3, more seldom-10-15 cm thick, are observed in the middle and upper part of the seam. Cleavages of the seam/ fig.57, face 10/ with the formation of "puff pastry", containing up to 45-50% of argillite interbeds are observed.

The seam roof is represented usually by coaly argillite, more seldom-aleurolite. In the workings it is sufficiently stable and favours carrying out driving with timbering only with partial covering the roof. The seam floor is represented by compact coaly argillite.

At a depth of 42 m along the seam dip, 1-1.5 m above water line in the river, a slight inflow of underground waters is observed as seepage and rare dripping from small fractures. The discharge is not less than 0.1 l/ sec.

Central section / VI/ - is located 1 km north-west of the south-eastern section on the same right side of the Rod-i-Karukh valley, 20-25m up its talweg / fig. 56/. This section was intensively exploited before. 6 or 7 more or less parallel slopes were located here along the dip of the coal seam down a depth of 120-150m/ according to the inquest informations/. The workings were located along the side / along the seam strike/ at an extent of 250-300 m. At present they are flooded with water, partly came down and are inaccessible for inspection.

The minute sequence of the middle Jurassic deposits, compiled in this section, was given in the corresponding section of the Chapter "Stratigraphy" before /fig. 10

A coal seam/ "lower"/, situated 22 m up the basement of the middle Jurassic sequence and 50.9m down the bed of Albian basal conglomerates, is in the central section. The coal seam has a persistent azimuth of dip to north /0-350°/ at an angle of 13-15°.

A coal seam, at a depth of about 25 m with an apparent thickness of 2 m is stripped in one of the workings. The structure of this seam is complex. The thickness of coal interbeds is 1.08 m. The thickness of the coal seam reaches 1.5 m at a depth of 100-150 m in the slopes according to the inquest data. Cleavages and pinching out were observed.

The works at the central section were stopped because of water inflow and general considerable depth of the slopes, making the output difficult.

North-western section/VII/ is located I km north-west of the central section, in the arrow-shaped portion of land between two confluent streams of the right tributary of the Rod-i-Karukh river, falling into it down the settlement Hamam. There are come down , desolate workings, situated at a height of 50-60m above the valley talweg /fig. 58/. They are located at an extent of I50-200 m along the slope / along the seam strike/.

The sequence of coal-bearing deposits of this section is shown in fig. I0.

The coal seam,I.0 m thick, lies here 40 m down the basal bed of Albian conglomerates.It is of simple structure, and is underlain by compact aleurolites and is overlain by coaly argillites. The dip is the same- to north at an angle of I4°.

In the sequence of the north-western section, down the main seam there are a row of coal partings ,up to I0 , more seldom-I5 cm thick, are observed. 36 m down- a coal seam of simple structure, 25 cm thick,occurs.

The sequence comparison ,taking the analyses rhythms of sedimentation into consideration, gives ground to suppose that the mentioned coal seam /"upper"/ is an independant seam and is not observed in the central and south-eastern sections of the deposit. A stratum with a coal seam ,25 cm thick, ,lying 76 m down the bed of base basal conglomerates of the Albian stage, corresponds to the "lower" seam of coal, stripped in the south-eastern and central sections.

Summing up all the data of the three described sections, it is necessary to underline some geological peculiarities of the deposit, determined as a result of the carried out works.

Taking non-persistence of the sequences structure of the coal-bearing strata into account, we can compare the sequences with each other, which are not distant, from one another, using the analysis of rhythm of the deposits. Such a rhythm-analysis helped to ascertain two coal seams of minable thickness in the deposit, which are on different stratigraphic strata. The "lower" seam , lying 20-30 m up the basement has a maximum thickness of over 2.6m in the south-western section. It thins out in a north-western direction:its thickness is not over I.5 m in the central section, and not over 0.25 m -in the north-western section.

The "upper" seam, lying 30-40 m up the "lower" one has a maximum thickness of 1 I.0 m in the north-western section.Its thickness decreases in a south-eastern direction: only a coal parting ,0.I m thick, is observed in the level of this seam in the central section.

Besides the mentioned two seams, there are beds of coaly argillite with frequent coal partings, from 5 to I5 cm thick, in different levels of the middle Jurassic sequence. They amount to 40-50% of the total seam thickness. New coal seams of minable importance can appear in these levels.

Petrographic and technical / moisture -W^c, ash-A^c, volatiles -V^r and sulphurousness -S^c total/ studying of the coals of the Madjed-i-Chob-i- deposit, made by M.A. Marshanskaja/Judina / and L.M.Andreeva give the idea of their quality.

The " lower" seam in the aditolike working of the south-eastern section was sampled along two seam-intersections in the deposit. Samples Nos 7-137-I,2 and 3, chosen in point No.6, characterize highly oxidized and weathered coal of the near-surface part of the seam; samples Nos T-437-I and 02 , chosen in point No.I4, characterize less oxidized coal from a depth of 30-35m along the seam dip, and apparently, give a more right idea of the coal quality of the deposit as a whole.

The coal from point No.6 is rather highly crumpled, argillaceous minerals and quartz are rubbed into fractures and gliding planes. The content of glossy and semi-glossy differences of coal changes from 60 to I00%.

The coal from point No. 6 is represented by lumpy difference, composed wholly of clarain differences.

The content of mineral impurities is correspondingly different/ see table No.5/.

In the samples from point No.6 argillaceous minerals are contained in a quantity of I0-24% , quartz-2-5%. In the coals from point No. I4 these minerals are practically absent. A considerable quantity of pyrite-3-4% is characteristic of the deposit coals Pyrite is seen along fractures as well as in a scattered form, incrusting vitrain matter of coal. The lower band of the coal seam in point No. I4 contains a small quantity of calcite, filling small fractures.

The weighted average calculation ash content of the coal in point No. 6 is 26.9%, in point No. I4- 9.6%. The specific gravity of the coal is correspondingly I.60 and I I.46 .

The material composition of the coal is characterized by a rather considerable content of components of the vitrain group/V/-75-82%. The semi-vitrinite group /SV/ is contained in quantities -9-I8%. the fusinite group /F/-5-9%; leucitite-/L/,mainly microtores is a value less than 2%.

The sum of thinning components / ok/ ,influencing the coking properties of coal, is I6-I9%.

The coal enrichment is determined in all the chosen samples / table No. 6/.

The coal from point No.6 at crushing down to -I.5 can give a concentrate with ash content up to I0% in an amount of 46-64%, the enrichment being difficult and very difficult.The raw coal from this point do not give any concentrate.

Sulphurousness of the initial coal ranges between I and 2%. The predominant quantity of pyrite will pass on to the concentrate at enrichment, and thus, the concentrate of coal enrichment of the upper and lower parts of the seam will be [illegible] of higher sulphurousness, than the initial coal.

The coal enrichment from point No. I4 is characterized as "average". The concentrate yeild at crushing down to I.5 mm reaches 85-89% at ash content 4-5%. The raw coal gives low- ash content [illegible] concentrate in a quantity of 60-80%. Sulphurousness of the initial coal is very high, over 3%. A considerable quantity of pyrite will pass on to the concentrate together with organic mass at enrichment. Sulphurousness of the concentrate will be high, approximately I-3%.

The coal metamorphism of the Madjed-i -Chob- i deposit is determined as II_2- gas average-metamorphosed.

The following technological indices should suppose for the [illegible] separation coals of low ash content:yeild of volatile matters/V^r/-36-38%; thickness of the plastometric seam /y/-I2-I4mm, carbon content- about 83%. The calorific capacity for combustible mass in a bomb /Q^r /-7900-8500cal.

The coal from point No. 6 will not give coke due to high ash content. The coal from point No.I4 can give coke with yeild up to 58% with high sulphurousness.

According to the data of the technical analysis /table No. 7/ the coals of Madjed-i-Chob-i are not very highly oxidized. Their moisture ranges between 2,0 and 2.23%. The ash content in point No. 6 ranges from 5.78 and 32.90%; in point No.I4- the ash content is low. Yeild of volatile matters for the coal with low ash content is 32.64-33.90%. The coals possess caking properties. Sulphurousness of the coals/ /total/ ranges between I.5I and 2.59 in point No.6 and between 3.03 and 3.07 in point No. I4.

Table No. 7

Point No.	Sample No.	W^a	A^a	A^c	S^a	S^c	V^r	Characteristic of the coke button
6	T-437-3	2.00	27.89	27.45	I.59	I.62	33.38	Caked
	T -437-2	2.I0	32.28	32.90	I.42	I.5I	34.08	"
	T-437-I	2.33	30.78	3I.55	2.53	2.59	35.50	"
I4	T-438-2	2.23	7.I3	7.28	3.00	3.07	32.64	Remelted,blistered.
	T-438-I	2.I0	5.63	5.78	2.9I	3.03	33.90	

The given data show that the coals of the Madjed-i-Chob-i deposit can be of limited interest for industry. They can be used with great effectiveness for energetical purposes.

The coal reserves of the Madjed-i-Chob-i deposit are rather limited up to now:

a/ the reserves will be I,680,000tons in the "lower" seam within the limits of the south-eastern and central sections in the block I500m x500m xI.6m with the specific gravity I.4.

b/The reserves will be I,050,000 tons in the "upper" seam within the limits of th

Thus, the total oriental reserves of coal down to a depth of 500 m / along the dip / are 2,730,000 tons. These resefves can be, probably, doubled at tracing coal seams along the dip with the help of sinking a row of bore holes along the line, located I km north of the deposit and parallel to the seams outcrop. The depth of these holes will not exceed 300-400 m at location of them in valley cuttings.

Boring in deep cuttings north of the Madjed-i-Chob-i deposit of the Laman, 6-I0 km is of especial interest. Either basal conglomerates of the Albian stage or its roof crop out in a row of places at the stream brink. If we could strip the coal-bearing deposits of the middle Jurassic under the Albian deposits, the coal reserves and general perspectives of the Madjed-i-Chob-i deposit would increase. The depth of the holes , necessary for this will be hardly over 250-300 m.

The following should be mentioned in conclusion. The rupture tectonics, manifested in the deposit region in pre-middle Jurassic and pre-Albian time, complicated very much the conditions of occurrence of the coal-bearing middle Jurassic deposits. In connection with this it is nearly impossible to foresee the pre-Albian structural plan of the area, overlain by rather thick strata of the Cretaceous deposits, poorly dislocated. The mentioned can bring to unexpected things at prospecting the coal-bearing area, and in particular to omission of coal-bearing Jurassic there, where it is very difficult to suppose now.

IRON /VIII-X/.

The iron manifestations are connected with the zones of metasomatism and in particular with scarn formations. They were fixed in three points:

I/ on the northern versant of the Selsela Koh-i-Dawindar, in the upper course of the Kushast /VIII/ the coordinates 34°28'05''N.L. and 62° 59' 26'' E.L.;

2/ in the upper course of the Rod-i-Karukh, I.5 km south-south-west of the Madjed-i -Chob-i coal deposit /IX/, the coordinates :34° 34' 35" N.L. and 63°09' 00" E.L.;

3/ on the right side of the Tagab-i-Mohammad Khan valley in its upper course /X/, the coordinates:34°36'II"N.L. and 62° 57' I2" E.L.

The first two ore manifestations are confined to the schistose strata with limestone interbeds of the Palawan suite of the lower Carboniferous /C_I pl/ and are not immediately connected with outcrops of intrusive rocks. The latters are observed at a distance of 3-4 km from them and are represented by diorites - /T_3-T_I/.

In the Kushast valley the ore deposit lies conformably with phyllite-like schist containing them, on the contact with limestones and has a dip azimuth of I80°, and an angle of 40°. It has a thickness of 4.5 m and is traced for I50 m. In the western end it is cut by a rupture, it is overlain by detrital deposits to east.

The ore is grained uniform magnetite, partly maghemitized and martitized with rare small inclusions of quartz, chlorite and nests, filled with calcite. Magnetite often forms pseudomorphisms post laminated hematite. Locally banded structure, conditioned by thin zones of replacement with prevailing quartz, is observed.

The spectral analysis of the ore showed the following content of the elements: /in %/: Cu-0.0I;Ph-traces;Zn-0.03;Ni-traces;Zr-traces.

In the crushed sample the mineralogical analysis fixed barite,malachite, pyrite, zircon,apatite,carbonate, iron hydroxides and green mica / apparently,chlorite/ besides magnetite and hematite.

In the second section south of Madjed-i-Chob-i a bed of altered greenish-pink fine-grained tuff of the Acid composition, I5020m thick,lying conformably with the phyllites, having the dip azimuth of I5° and angle of 30-40°, is distinctly seen. The tuff is highly carbonitized, chloritized, locally silicificated and contains a great quantity of fine-grained tourmaline.It is of banded structure and is saturated with hematite to a different degree.Besides, the latter forms deposits,from 0.5 to I.I m thick,irregular-lens-like or bedded in form, of rather pure magnetite-hematite ore /hematite-35-20%;magnetite-30-20%, maghemite-I0-I%, martite-I0-57%;single grains of chalcopyrite, pyrrhotite, pyrite/.A band of ore-bearing rocks is traced along the strike for I.0-I.5km,rounding the ridge between two adjacent valleys.From east it is cut with a rupture . The deposit area is not less than I sq. km. Along the outcrop the ore comes to the day sporadically, its disintegrated blocks piled up on mountain slopes are practically traced at the whole extent of the zone. However, it is not a proof of continuity of ore bodies, most likely they have an irregularly lens-like form.

The spectral analysis of the ore showed the following content of the elements: /in %/: Cu-0.0I;Zn-0.0I;Ni-0.00I;Ca-0.00I;V-0.0I;Cr-0.0I;Zn-0.0I;Ba-0.0I.

The third ore manifestation in the upper course of the Tagab-iMohammad Khan river is confined to scarnized Permian-Triassic rocks, the sequence of which was described in the section "Permian and Triassic systems, non-segmented". The bodies of epidote-garnet scarns, conformable with the containing rocks, reach a thickness of I-I.5 to 3 m here. They are, apparently, connected with a small intrusion of diorites, breaking Permain-Triassic deposits near the described place /0.5-0.6km/. Lenses and bodies ,irregular in form, of the magnetitic ore are often seen among epidote-garnet scarn. Separate blocks on the slopes reach / rare/ 0.5 m^3.Magnetite forms, apparently small dismembered bodies. The mineragraphic investigation shows that the magnetite develops out of non-metalliferous minerals: replaces garnet, and probably, amphibole The magnetite is partly replaced by martite. Sometimes pyrite and chalcopyrite are observed.

The ore manifestations of magnetitic and magnetite-hematite ores are genetically

spatially connected with metasomites and in particular with scarns, which , in their turn, are typical of the first phase of the upper Triassic-lower Jurassic magmatic c complex, represented by diorites - /T_3-J_I/, as it was shown in chapter IV"Intrusive rocks".

The described ore manifestations are very inconsiderable in their reserves, apparently. However,they can be of interest for local industry if to take the nearness of the Madjed-i-Chob-i coal deposit into consideration / especially the first two ones/.

Exposure of these ore manifestations is important for further prospects of iron ore deposits of larger scales, for example, in the regions, adjacent to the investigated ones and those ,situated east of them.

COPPER /XI-XXV/,

Copper manifestations are numerous in the investigated region, but none of them is of practical interest.

The country rocks are the formations of different age of the Palawan suite of the lower Carboniferous up to Turkestan deposits of the upper Eocene inclusive. Apparently their large part is connected with manifestations of young magmatism of the end of the Paleogene period; the less part - with intrusive processes of the upper Triassic-lower Jurassic.

All the fixed copper manifestations can be divided into four types depending on their form and character of distribution of ore components in them.

Fine impregnation of ore minerals in intrusive rocks-in diorites and porphyry-like granites appertain to the first type of mineralization /XI-XIII/.Usually they are thin /from 5 to I5 cm/ little zones of somewhat silisificated rocks in contact or in immediate proximity to it with an extent from the first metres to I00 m. The ore minerals are represented by chalcopyrite, bornite, magnetite, martite, pyrite, chalcocite,covellite; gold is seldom seen. Malachite and limonite are observed from the secondary minerals. According to the data of the spectral analysis* the following content of useful components was established: / in %/:

Cu -0.I-0.5.0 Pb- 0.003 Ag-traces-0.003 Bi-upto I.0 Ba- 0.0I-0.I Co-0.00I-0.003 Ni-0.00I V-0.0I-0.003 Cr-0.00I Zr-0.0I

Fine impregnation and veinlets of minerals in quartz veins appertain to the second type /XIV-XV/. Usually they are thin /0.3-0.5 m/ rare quartz veins with an extetent up to I0 and more metres/ seldom/.The ore minerals are represented by:chalcopyrite, chalcocite, covelline, barnite, cinnabar is seldom seen. Malachite and limonite are observed from the secondary minerals; barite-from the non-metalliferous.

The spectral analyses of the lumpy samples out of different veins with apparent

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*Three lumpy samples taken out of most enriched with sulphides areas.

sulphide mineralisation showed the following content/in %/:

Cu	Ag	Bi	V	Ni	Ba
0.03-5.0	0.I	0.03	traces-0.00I	traces	0.0I-0.03

Fine veinlets and impregnation of ore minerals in the zones of tectonic crushing apperatin to the third type of mineralization/XVI-XXII/.The shatter zones are usually poorly cemented with quartz and carbonate, formimg the system of fine disorderly oriented thin veinlets and nests. The sections extent ion of mineralization usually does not exceed 0.3-0.5 for 6-7 m. Impreganation of ore minerals is fine and rare / seldom nests up to I-I.5cm/ is represented by: chalcopyrite, bornite, covelline, galena, pyrite; from the secondary ones:cerussite, malachite, limonite. Barite occurs from the non-metalliferous. The results of the spectral analyses of five samples from most fol-enriched areas showed the following content of the components / in %/ :

Cu	Ag	Pb	Bi	Co	Ni
0.I-3.0	0.1-0.00I	traces-0.0I	0.003	0.00I-0.003	traces-0.003

Mo	As	V	Ba
0.003	0.0I-0.I	0.00I-0.003	0.065-0.I

Fine impregnation of ore minerals in sandstones of Permian and Eocene ages appertains to the fourth type /XXIII-XXVI/. Usually small sections, elongated the bed planes as lens-like bodies ,measuring up to I x 6 m with very fine impregnation of chalcopyrite, covelline, bornite, malachite, limonite, azurite and barite. The data of the spectral analysis of one specimen from most enriched areas showed the following/in %/: contaant of the elements / in %/:

Cu	Pb	Ag	As	Zn	Ba	V	Ni	Cr	Zr
3.0	0.03	0.0I	0.0I	0.0[illegible]	0.0[illegible]	0.0I	0.00I	0.0I	0.00[illegible]

As one can see from the given description the most widely-distributed types of mineralization is the third one, connected with the shatter zones of the rock,which are accompanied by relatively small rupture dislocations and they develop without evident connection with them.Apparently, there were favourable conditions [illegible] for fixation of ore components from solutions. As a rule, rupture dislocations, of large scales, and thick shatter zones of rocks, connected with them, have no mineralization features in the investigated region.

Fine ore mineralization in sandstones/ the fourth type of mineralization/ can be syngenetic to sedimentary rocks. This mineralization , apparently, appertains to th the type of "copper sandstones", widely distributed in Eocene red deposits in North-we western China.

The points of the copper mineralization, fixed in the studied area, are plotted on the attached [illegible] "Mineral resources map " under the corresponding numbers and are entered in the Catalogue of deposits and manifestations of minerals,which is in the annexes to the present report.

PHOSPHORITES /XXVII/.

The phosphorites in the investigated region are rare formations. They were observed in the basement of the Senoman section of the Cretaceous system in the section between the settlement Laman and the settlement Kotal-i-Sabzak. A bed, from 0.3 to 1.1 m / with the dip azimuth 350-10°, the angle -8-12°/ composed of phosphorite nodule irregular in form, gray or black in form, cemented with carbonate-phosphate material, lies with interbeds of sandstones and limestones among dark gray clays at a considerable space. The phosphorite nodules are from 0.5 to 5-6 cm. They contain up to 5-6% of non-phosphate inclusions, represented by grains of glauconite and quartz. The cementing phosphate-carbonate mass is enriched with non-phosphate inclusions, reaching 20% in the sum and represented by the same glauconite/ grains from 0.2 to 1.0 mm, seldom -up to 3-4 mm in diametre, seldom- fringes around phosphorite nodules/ and quartz.

Phosphoritized tests of ammonites, pelecypods, gastropods, etc, more seldom-nests of fine-crystalline calcite are seen in the main mass.

The chemical composition of two samples showed the content of P_2O_5 -6.2 and 9.7%. The spectral analysis ascertained the content /in %/: P- 3; Ba-0.3; Be-traces, Cu-0.003; Zr-0.01; Cr-0.001; Ti-0.03; Co-traces; Ni-traces.

The described phosphorites appertain to the platform type, to the nodule subtype / according to E.M.Himmelfarb/. In spite of the low non-minable content of P_2O_5, they can be of some prospecting interest. While conducting prospecting works for coal in the region of the settlement Laman and while boring the area between the pass Kotal-i Sabzak and the Madjed-i-Chob-i coal deposit, we should bear in mind that a phosphorite bearing bed can be found in the basement of the Senoman stage, probably, with higher content of P_2O_5.

CEMENT RAW MATERIALS /XXVIII-XXXI/.

Limestones and marlaceous limestones are not widely distributed in the investigated region. Their most considerable accumulations are confined exceptionally to the lower and middle sections of the Triassic and upper section of the Cretaceous system.

LOWER TRIASSIC LIMESTONES are known in the composition of the upper part of the Jawza suite /T_I jw /. They crop out in the middle part of the Rod-i-Maluma /XXVIII/, in the upper course of the Darra-i-Chartaq and 6-7 km north-east of the settlement Benosh Darra /XXIX/.

The description of the sequences of these deposits is given in the corresponding sections of chapter IV "Stratigraphy".

The most pure limetones, located in the most favourable conditions economically,

are limestones ,6-7 km north-east of the settlement Benosh -darra. One can get there in a car.There is a spring with a discharge about 2 l/sec and the rivulet Darra-i-Ben Benosh runs near the limestone outcrop. The discharge of water in the latter rivulet was 0.5 m^3/ sec in 1964. If the total thickness of the limestones is 464 m, their outcrop area is not less than 3 sq. km.

Limestones in the section, are different in their qualitative characteristic. The analysis of the samples, chosen from the middle and lower strata/ gray and pinkish compact aphanitic limestones/ showed the following contents:

Sample No.	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	ldh	SO_3
T-334	5.65	I.05	0.40	5I.65	0.65	40.24	0.072
T-II49	I2.55	3.60	I.00	45.83	0.70	35.82	0.085

The hydraulic modulus correspondingly / downwards/: 7[illegible].27 and 2.66. The silicate modulus-3.90 and 2.7I;the aluminous module-2.60 and 3.60.

As one can see from the mentioned analyses and modula :
the limestones of Behosh -darra appertain to the group"A" by the content of M in them and can be used as cement raw materials when putting aluminiferous and ferruginous additions in the raw materials mixture .

MIDDLE TRIASSIC LIMESTONES compose the Sanjar suite /T_2 sn/.They crop out only in the interfluve of Rod-i-Maluma and in the right componenet of the Rod-i-Sanjur, where they are traced to northeast of the settlement Jawza at an extent of 5-6 km. Their thickness reaches 4I0 m. These limestones were described before / page 67/. In the qualitative respect they are rather different. Limestones, fit to usage as cement raw materials, can be found among them.

The limestones distribution is less favourable in the economical respect,i,e. it is necessary to construct a motor road not less than I0 km in extent, to get there There is the Rod-i-Sanjur rivulet with a discharge not less than Im^3 per sec. near the outcrop of the limestones.

UPPER CRETACEOUS LIMESTONES, MARLACEOUS LIMESTONES AND MARLS /XXXI/ compose thick strata of the Turonian, Coniacian, Santonian, Campanian and lower part of the Maastrichtian stages in the spatial territory of the northern [illegible] versants of the Selsela Koh-i-Band-i-Baba and Band-i-badgisat. The most accessible section, where these rocks developed, is located along the motor road from Kalai-Nau to the pass Kotal-i-Sabzak, and especially in the region of the settlement Laman.

In the region of the settlement Laman marls and marlaceous limestones of the mentioned age have the total thickness of about 300 m. Their upper argillaceous part with the thickness of about 150 m/ Santonian, Campanian and lower part of the Maastrichtian stage/ was sampled. Samples were taken with intervals of 45-50 m.

The analysis results are the following/in %/:

Sample No	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	ldh	$S_{tot.}$
T-5612-k /top/	29.22	7.25	3.45	29.95	I.84	25.69	0.I3
T-5612-l. /middle/	20.24	5.67	2.59	37.57	I.I8	30.99	0.I0
T-5612-M/bottom/	I8.98	4.43	2.I3	39.88	0.94	32.42	0.09

The hydraulic modulus correspondingly /downwards/:0.75,I.3i, I.56.
The silicate modulus -I.7I,2.70,2.89 The aluminiferous modulus-2.II,2.I9,2.0.
The coefficient of saturation is correspondingly-0.20,0.I7,0.60.

The marls of Laman appertain to the group A^I and can be used as cement raw materials with correcting addition of pure limestone, the marl of the sample T-5612-M has the most favourable composition. For its correcting a minimum quantity of pure limestone ,which can be found just here among the deposits of the Cenomanian and Turonian stages,is necessary. Thus, two samples of Turonian limestones, chosen 3 and II km south of the settlement Laman near the motor road showed the following results.

Sample No	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	ldh	$S_{tot.}$
T-I368 4 km south of the settlement Laman	4.64	I.34	0.70	5I.93	0.69	40.75	0.I70
T-36I8	II.88	3.22	0.92	45.69	0.86	36.82	0.230

The hydraulic modulus is correspondingly/downwards/: 7.78 and 2.86;the silicate modulus-2.88 and 2.30;the aluminiferous modulus-3.50 and I.90. As one can see from the given data the Turonian limestones require an aluminiferous addition / clay/ for preparation of the cement mixture or can be used as additions to the marls, described be before.

Gypsum is observed incidentally only in the upper part of the Maastrichtian-Danian stage, specifically in the region of the settlement Laman. The gypsum thickness reaches I m in lenses. The gypsum is white, gray, pink, locally argillaceous, of of massive and cloddy structure. Additional investigations and sampling will be necessary for its usage for the cement mixture.

Clays IN THE INvestigated region are distributed very limitedly. They are known among the sediments of the Cretaceous system and among the Quaternary deposits.

Clays of the Cretaceous age can be found only in the tops of the Albian and the basement of the Cenomanian stages south of the settlement Laman near the pass Kotal-i-Sabzak. They are gray, dark gray foliaceous or cloddy, often micaceous, poorly calcareous, poorly got soaked clays with interbeds of sandstones, aleurolites and platy-limestones. However, some bands of rather pure clays reach I-5 m and over

in thickness. They can be used, apparently ,for making cement mixtures. However,chemical and granulometrical investigations are necessary for the final notion of their quality.

Clays of the Quaternary age are represented exceptionally by loesses and loess-like loams, which are rather widely distributed south of the settlement Laman/ beyond the limits of the work region/ amd in the Karukh intermontane depression.

In the Karukh depression they overlie the middle Quaternary surface, composed of proluvial-alluvial-lacustrine deposits/ pl-al-l Q_2/ as erosive outliers of a considerable area / the first sq. metres/ with the thickness up to 3-4 m , and locally up to 15-18 m.

Their composition is not constant: they are more or less calcareous, sometimes-with lime- nodules, sometimes they contain lenses, enriched with aleuroliti and sandy material.For determination of their fitness in cement mixtures it is necessary to make chemical and granulometrical analyses of every section separately.

BRICK CLAYS.

LOESses and loess-like loams, widely distributed in the Karukh depression, can be used as brick earths. However, high calcification and inclusions of lime nodules will limit their usage for making burnt brick . They do not contain noxious admixtures in some sections,for example, in the region of the settlement Karukh,Maluma and Dalantu Brick earths can be found here, which will satisfy the necessary requirements.

PEBBLES AND GRAVEL SANDS

Pebbles and gravel sands are distributed limitedly in the investigated region and are known only along the valleys of the longest rivers, such as Darya-i-Kushk and Rod-i-Karukh.

The pebbles and gravel sands consist mainly of fragments of limestones and sandstones with impurity of igneous rocks. The heterogenous composition of the pebbles and gravel sands sharply decreases their quality.

HEAVY CONCENTRATE SAMPLING.

Heavy concentrate sampling was carried out with the purpose of exposing minerals by the mechanical dispersion halos,of minerals.

The recent loose alluvial and alluvial-proluvial deposits of large channels and their tributaries were subjected to sampling. The density of the sampling points of heavy concentrate samples depended on the peculiarities of the geological structure of

of some sections. Thus, in the regions of development of Cretaceous, Paleogene a Neogene deposits the net of sampling was not so dense. The areas of the developme of the Paleozoic and Triassic deposits, and also of intrusive rocks, were sampled with a denser net. Inaccessible areas, for example, such as the middle course of the Tagb-i-Mohammad Khan, etc . were not subjected to sampling.

Sampling of heavy concentrate samples of a weight of 18-20 kg was carried ou from small pits ,0.4 m deep. The heavy concentrate samples were washed in wooden chutes up to "a gray heavy concentrate". The heavy concentrate weight reached 1.5 15 gr, and 8 gr. at an average.

While preparing the heavy concentrates for the mineralogical analysis three fractions were distinguished: 1/ magnetic, 2/ heavy electromagnetic, 3/heavy no electromagnetic. The weight of the first one ranged between 0.01 and 10.0 gr, 3 gr. at an average; the weight of the second fraction 0.05 to 8 gr. 2 gr. at an average, the weight of the third fraction ranged between traces and 0.6 gr,0.02 at an average.

Magnetic fraction is represented only by magnetite.

The heavy electromagnetic fraction is represented by iron hydroxides, mart hematite, which compose its main mass,the minerals of the epidote group are seen more seldom. Besides, the following minerals were found in the composition the fraction:

ilmenite- from rare grains to 10-15%[x/] frequent grains/ traces/ prevail/;
alanite-from rare traces to 5%, frequent traces prevail;
sphene-from rare traces to 40%, frequent traces prevail;
garnet- from rare traces to 15-20%, rare traces prevail;
chromite-from rare traces to 30%, rare traces prevail;
epidote- from rare traces to 100%, traces prevail;
pyroxenes-from rare traces to 30%, traces prevail;
arsenopyrite, tourmaline, pyrolusite, hornblende-rare traces; amphibole, biotit leucoxene-traces.

Heavy non-electromagnetic fraction is represented by barite, zircon and ru which compose its main mass. Besides,the following minerals were fixed in the c position of the fraction:

apatite-from rare traces to 50-60%, the first per cents prevail;
leucoxene-from rare traces to 50%, traces prevail;
andalusite-from traces to 30-40%, traces prevail;
scheelite-from rare traces to 70%, traces prevail;
zircon-from traces to 90%, the first per cents prevail;
rutile-from traces to70-80%, the first per cents prevail;

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x/ from the weight of the given fraction/ here and further/.

galena, cerussite, wulfenite,minium, cuprite, malachite, thorite, basobismutite, vanadinite, diopside, pyrite, brookite-traces;
cinnabar, monazite, gold, fluorite, sphalerite, corundum-rare traces.

Useful minerals. II useful minerals were fixed with the mineralogical analysis: cinnabar, scheelite, gold,arsenopyrite, fluorite, basobismutite, sphalerite, lead minerals/ wulfenite, galena, cerussite, minium, vanadinite/, minerals of rare earths / xenotime, allanite,monazite /, copper minerals/ cuprite, malachite/,minerals of thorium/ thorc zircon, thorite/.

More or less distinct mechanical dispersion halos are given by : cinnabar,scheelite, gold, lead minerals, minerals of rare earths and thorium minerals from the number of enumerated useful minerals.

The rest minerals are distributed either individually or everywhere, without any distinct regularities / for example, barite/.

Appearance of an anomalous number of heavy concentrates with a content of some or other mineral at a comparatively limited area/ river basin /or its tributaries/are taken as a principle of distingishing mechanical dispersion halos. The quantitative content of the useful mineral was also calculated in every sample.

In the mineral resources map useful minerals and their dispersion halos are made in different colours / see conventional signs in the mineral resources map/.

Cinnabar /HgS/ is seen as single grains / up to I5 grains/ measuring up to 0.5 mm in heavy concentrates. Its single grains are observed throughout the whole territory of survey and are connected, apparently, with low-temperature hydro-thermas appearing here due to intensive young rupture tectonics.In some cases there is a genetic connection of cinnabar with the dike complex and effusions of the basic and intermediate composition.

The only dispersion halo of cinnabar, exposed by us, is located in the centre of the survey area, on the eastern end of the ridge Selsela Koh-i-Band-i-Baba in the region of the pass Kotal-i-Zarmast. Here cinnabar is present in six heavy concentrates, taken in the section of the development of the Permian red deposits, broken with dikes of the intermediate and basic composition. In all the samples the content of the mineral is rare grains.

The area of the dispersion halo is I0 km^2.

Scheelite/$Ca W O_4$/ is seen in grains, measuring 0.1-I.0 mm in a quantity up to 2 2.2 gr for 1 m^3 /sample No.2852/. The mineral is observed mainly in heavy concentrates, chosen near granite intrusions. It is in the composition of granites as an accessory mineral, and ,besides, can be contained in contact-changed rocks, though examination of the latters had no positive results.

Two dispersion halos are exposed : a/ on the eastern end of the ridge Selsela Koh

Koh-i-Band-i-Baba, in the region of the pass Kotal-i-Zarmast, where scheelite is present in 12 heavy concentrate samples. The mineral content in the samples ranges between rare grains and frequent grains. The halo area is 13 km^2;

b/ The ridge Koh-i-Asmani, where scheelite is present nearly in all the samples of heavy concentrates, located in this section. Quantitatively scheelite is contained from rare traces to the first per cents. the anomalous quantity is observed in samples 2852-2.2 gr/m^3 and 3374, 3375 -I-I.5 gr/m^3. The halo dispersion is 250 km^2.

Gold /Au/in heavy concentrates is seen in small quantities, as single grains / not more than I5 grains/, its grains are round and not round, hooked, measuring 0.I-0.5 mm/ Rare grains of gold occur throughout the whole territory, and its amount increases only in the south in the region of the settlement Maluma and in the upper courde of the Rod-i-Maluma river.

The sampling results allowed to delineate one dispersion halo of gold, located near the foot of the ridge Selsela Koh-i-Davindar, 7-8 km south of the settlemnet Maluma. Gold occurs in 7 heavy concentrate samples here. The gold content in them is represented by rare traces and only in one sample /No. 2518/ I5 grains are observed. The halo area is 45 km^2. This halo has no practical meaning, apparently.

Fluorite /$Ca F_2$/ crops out in single grains in three heavy concentrates, chosen east of the settlement Lama.

Basobismutite/$Bi CO_5$/ occurs seldom and in small amounts /grains/. Dispersion halos are not observed.

Sphalerite /Zn S/ is seen in single heavy concentrates together with galena, in a quantity of the first grains.

Arsenopyrite /Fe As S/ occurs in three heavy concentrates as single grains.

Lead minerals /Pb/ -wulfenite /$Pb M_o O_4$/, galena/Pb S/, cerussite/$Pb CO_3$/, minium /$Pb_2Pb O_4$/, vanadinite /$Pb_5Cl V_3 O_{I2}$/ are present in 70% of heavy concentrate samples in a quantity of rare grains to frequent grains. The grains size -0.I-0.6 mm. These minerals are seen throughout the whole area, but the dispersion halo is distinguished for them only in the west of the region. This halo is located in the upper course of the Dara-i-Chartaq, where the minerals of lead are seen in 24 heavy concentrate samples, half of which contains rare grains of lead minerals and the rest- frequent grains. The section is composed of the rocks of the Permian up to Upper Eocene, which are in complicated tectonic interrelations. The area of the dispersion halo is 50 km^2. The lead minerals, are, probably, connected with low-temperature hydrothermal manifestations in connection with numerous young rupture dislocations here.

Minerals of rare earths ?TR/-xenotime /YPO_4/, monazite/$CePO_4$/, allanite /H $(Ca,Ce)_2$ $(Al,Fe''',Fe'')_3$ Si_3O_{I3}/- occur in most heavy concentrates, chosen in the north-western and south- eastern parts of the investigated territory in quantities fro

from single grains to 12.3 gr for 1 m^3/ sample No.2857/.These minerals are accessory for porphyre-like granites / $\gamma(T_3-J_1)$ / and ,besides, were seen in rare pegmatitic v veins.

Their dispersion halos are observed:

a/in the middle course of the Darra-iJowal, Here these minerals are observed in 13 he heavy concentrate samples with rare grains. The halo area is 32 km^2.

b/in the south-eastern part of the ridge Kohi-Asmani.These minerals are present in mo most heavy concentrate samples, chosen within the limits or near the intrusion of por phyry-like granites. Quantitatively the minerals are from rare grains to the first per cents. Anomalous contents are seen in samples No. 2857 -12.3 gr/m^3 and No.2818 -1.0 $gr./m^3$. The halo area is 180 km^2.

Thorium minerals /Th/ -thorite /Th $Si O_4$/, thorozircon /Zn (TH) $Si O_4$/ OCCUR as single and frequent grains in the regions of the development of intrusive rocks, and, apparently, are the minerals of the accessory origin. Their halos of dispersion are fixed:

a/ on the left side of the Rod-i-Karukh valley in the region of the settlements Balantu and Kushast / 15 heavy concentrate samples/. The content of thorium minerals ranges between rare and frequent grains. The halo area is 28 km^2.

b/ in the upper course of the Rod-i-Maluma valley /12 heavy concentrate samples/. The minerals are represented by rare grains in the samples. The halo area is 35 km^2.

c/ along the left tributary of the Rod-i-Karukh, 8 km east of the settlement Kushast / 4 heavy concentrate samples/. The content is from rare to frequent grains. The halo area is 10 km^2.

Copper minerals /Cu/-cuprite /Cu_2O/, malachite /$Cu(OH)_2 Cu CO_3$/ OCCUR in a small amount throughout thw whole area of the region, mainly as single grains /only in heavy concentrate No. 3368 1.5-2% of malachite are seen/. Copper minerals do not form halos of dispersion.

The dispersion halos of the useful minerals, shown in the mineral resources map are of no practical interest, apparently. However, they should be taken into account while conducting prospects of useful minerals later on in the investigated area as well as while carrying out geological survey and prospecting works in the adjacent territories with the similar geological structure.

CHAPTER VIII. CHARACTERISTIC OF UNDERGROUND WATERS.

With the purpose of gathering material for the characteristic of water presence in the exposed strata and compiling the map of water-bearing points in the Herat area outflows of underground waters were fixed , discharges and water temperatures were measured in the process of the geological survey. A total of 43 water-bearing points were studied. From 41 water-bearing points water samples were chosen and reduced chemical analyses were made.

The outflows of underground waters are represented mainly by gravity and very seldom-ascension springs, confined to the lines of tectonic fractures and separate fractured zones / see "Map of water-bearing points", combined with "the mineral resources map"/. All the springs are located at altitudes 1440-2850 m. Their elevation above the local basis of erosion / water line of the Karukh river/ ranges between 600-1300m.

Feeding of underground waters is realized due to infiltration of precipitations water inflow by tectonic fractures and fractures of weathering crust from inudated rocks, lying in higher bench marks .

In the investigated territory the underground waters are seen in non-divided Paleozoic, lower Carboniferous, Permian and Triassic, Jurassic, Cretaceous and Paleogene deposits.

Within the limits of the development of Neogene and Quaternary deposits outflows of underground waters are not found.

A brief characteristic of the underground waters of water-bearing strata is given below.

UNDERGROUND WATERS OF NON-DIVIDED PALEOZOIC AND LOWER CARBONIFEROUS DEPOSITS /$Pz_I C_1$/.

The underground waters of these deposits are distributed in the south-eastern part of the studied territory. They are combined into one water-bearing complex in connection with the similar chemical composition .The water-bearing rocks are fractured quartzy-sericitic, argillite-like shales, granites and granodiorites.

On the surface the outflows of the underground waters are confined to the lines of tectonic fractures and are represented by gravity springs, with the exception of the areas broken by young intrusions, where two ascension springs with the water temperature -46-47°/2799,2800/ flow out in the contacts of Paleozoic schists with granites and granodiorites. A total of 7 springs occur in the area of the development of non-divided Paleozoic and lower Carboniferous deposits, from which 4 springs are confined to the lower Carboniferous deposits with small discharges 0.001-0.2 l/sec.From three springs of non-divided Paleozoic deposits two springs / high-temperatured/have

discharges I.2-2.0 l/sec and one spring / cold/-0.02 l/sec. The water temperature of the lower Carboniferous deposits is I2-I4°.By their chemical composition the waters are sulphate-hydrocarbonate magnesium-sodium-calcium. Sometimes the cations change in places:

$$M_{0.2}\ \frac{HCO_{85}^{3}\ SO_{8.5}^{4}}{Ca_{62}\ Na_{2I}\ Mg_{I4}}$$

Mineralization of the water of the springs -0.3-0.6 gr/l.

The total hardness-2.3-5.4 mgr/equiv. Ph=7.I-7.8

The waters of the high-temperature springs are chloride-hydrocarbonate-sulphate calcium-sodium:

$$M_{0.3}\ \frac{SO_{5I}^{4}\ HCO_{2I}^{3}\ Cl\ I0}{Na_{84}\ Ca\ I4}$$ /spring No.2799/.

The water mineralization-0.26-0.3 gr/l. The total hardness of them is 0.58 mgr/equiv. Ph=6.3-6.9.

UNDERGROUND WATERS OF PERMIAN AND TRIASSIC DEPOSITS

/P_1T/.

The waters of these deposits are confined to the zone of tectonic fractures, crossing the central part of the studied territory in a latitudinal direction.

The water-bearing rocks are fractured sandstones, conglomerates, more seldom-aleurolites, porphyrites and limestones . On the surface the underground waters are fixed by outflows of gravity springs. A total of I5 springs are studied. The water di discharge ranges between 0.2-I.7 l/sec. The temperature is I0-I6°. The chemical composition of the water is chloride-sulphate-hydrocarbonate magnesium-sodium-calcium and sulphate-hydrocarbonate. Sometimes the cations change in places:

$$M_{0.4}\ \frac{HCO_{68}^{3}\ SO_{I9}^{4}\ Cl_{I2}}{Ca_{48}\ Na_{30}\ Mg_{2}}$$ /spring No.224/.

The water mineralization is 0.3-0.5 gr/l. The total hardness is 1.36-6.7 mgr/equi Ph=6.5-8.0

UNDERGROUND WATERS OF MIDDLE JURASSIC AND UPPER CRETACEOUS DEPOSITS.

/J_2Cr_2/

These waters are rather limitedly distributed in some sections in the north-

western, north-eastern, central and eastern parts of the studied territory.

Four gravity springs and one ascension spring occur in the Cretaceous deposits.

Water presence of the Jurassic deposits is ascertained by the flooded adit /438/. The water-bearing rocks are fractured and broken with tectonic fractures, sandstones, argillites and coal. The springs discharge ranges between 0.5-3 l/sec. In the adit the water discharge was 0.04 l/sec in the June of 1964. The water temperature of the sp: springs is II-I5°C, it is I4°C in the adit. The chemical composition of the water of the Jurassic deposits in the adit is sulphate-hydrocarbonate sodium-magnesium-calcium. The waters of the Cretaceous deposits are sulphate-hydrocarbonate sodium-magnesium-calcium, more seldom-hydrocarbonate-sodium.The cations change their places sometimes:

$$M_{0.5} - \frac{HCO^{3}_{70}\ SO^{4}_{25}}{Na_{39}\ Ca_{36}\ Mg_{I4}}$$

Six springs are studied in the area of the development of the Cretaceous deposits two of them /Nos 2242,2285/ are with heightened mineralization-I.5-3.5 gr/l and the total mineralization -I8.0-23.5 mgr/equiv. Ph=6.8-7.I.

In the rest springs the water is fresh with mineralization 0.4-I.I gr/l. and the total hardness 3.25-I0.9 mgr/equiv. Ph=6.8-7.7.

UNDERGROUND WATERS OF PALEOGENE DEPOSITS, /Pg_{I-2}/.

The waters of these deposits are mainly spread in the northern part of the studied territory. Their outflows are observed in some areas in the central and southern parts of the territory. All the springs are gravity ones, which are confined to the lines of tectonic fractures and to some fractured zones of crust of weathering. The water-bearing rocks are sandstones, conglomerates, limestones, marls and effusive rocks. A total of I6 gravity springs are fixed. The water discharges range between 0.003 and 3.0 l/sec. The temperature is I0-20°. The water is without smell. By the chemical composition the waters are sulphate-hydrocarbonate sodium-magnesium-calcium. Sometimes the cations change in places.

$$M_{0.4}\frac{HCO^{3}_{84}\ SO^{4}_{29}}{Ca_{52}\ Mg_{32}\ Na_{17}}$$

The water mineralization is 0.25-0.7 gr/l. The total hardness -0.88-8.44gr/equiv. Ph=6.5-7.9.

The water of spring No.I823 has heightened mineralization-2.I gr/l.The total hardness of the water is 28mgr/equiv.Ph=7.3.

The above mentioned data of the water presence in the strata point to the fact , that the geological structural, geomorphological and climatic conditions of the studied territory do not favour intensive feeding and accumulation of underground waters. The underground waters here have a sporadic distribution in the rocks, broken by tectonic dislocations,and in some areas, where exogenic fracturing is developed.

Most water-bearing points have small discharges /down to I.01/sec. Only some of themare with discharges 2-3 l/sec.Nearly all the water-bearing points contain fresh, moderately-hard, sulphate-hydrocarbonate magnesium-sodium-calcium water. In the waters of different water-bearing points the cations change in places. In most water-bearing points the water contains ammonia, nitrates and nitrites, which points to their contamination.

The springs with heightened mineralization /Nos 2242, 1823,2285/ of Cretaceous and Paleogene deposits, and also fresh high-temperatured springs -/2799,2800/ in non-divided Paleozoic deposits are of balneological value. High-temperatured springs and cold spring No.2285 are used by the population for medicinal purposes at present.

The surface waters in the studied territory were not studied. Very brief data of them are given in chapter I.

CONCLUSION.

As a result of the conducted geological survey and prospecting works for coal on a scale of 1:200000 in the Herat province at an area of 3400 sq.km. , planned for this purpose by the Ministry of Mines and Industries of the Royal Afghanistan, compiled the following graphical and textual materials were compiled:

A. SPECIAL MAPS.

1. Geological map / on the topobase of a scale of 1:100000 / with the summary of stratigraphic column and four geological sequences.

2. Mineral resources map / on the topo base on a scale 1:100000.

3. Map of water-bearing points / on the topobase 1:100000, combined with the mineral resources map/.

4. Tectonic sketch map /on the topobase on a scale of 1:300000- in the report text/.

5. Geomorphological map /on the topobase of a scale of 1:300000 -in the report text/.

6. Map of factual materials / on the topobase on a scale of 1:100000/.

B. GEOLOGICAL REPORT, containg the necessary chapters and section.

The main results of the investigations, given in the present report, are the following:

1. Sufficiently fractional / in most cases-up to stages and suites/ stratigraphic dismembering of the deposits, developed in the region, beginning from Lower Carboniferous and finishing with Quaternary ones,was made.The deposits of the lower, middle and upper sections of the Triassic system are distinguished and minutely dismembered in the investigated region and generally in Northern Afghanistan for the first time.The middle Jurassic age is ascertained for the coal-bearing strata.of the Madjed-i-Chob-i deposit. The deposits of the Cretaceous and Paleogene systems are minutely dismembered. The Quaternary deposits are studied for the first time.

2.The intrusive rocks of the region, among which four phases of different age are distinguished, are studied. The upper Triassic-lower Jurassic age is ascertained for the intrusions.

3. Extraordinary tectonic mobility of the region up to the middle Jurassic epoch inclusive is ascertained.The tectonic movements were mainly of the orogenic character. Six phases of tectonic movements are distinguished in the interval from the middle Paleozoic /Pz_2/ up to the middle Jurassic /J_2/, four of them /C_2-P;P-T_I;T_2-T_3;T_3-J_I/ were accompanied by folding. The most considerable phases by folding intensivity apper tain to the intervals between middle Carboniferous and Permain/ probably,Asturian phase/ between Permain and Lower Triassic / probably,pfalts phase/ and between the upper

Triassic and middle Jurassic/probably ,Don phase/. The following tectonic movements were of the very intensive character in the period from the middle Jurassic to the Albian sea transgression, but they were connected exceptionally with block displacements along rupture dislocations of a sublatitudinal direction. The later phases of the Albian stage manifested in the following post-middle Eocene time. Considerable lava flows of the platform type / basalts, andesites, trachytes/ preceded to them. The most intensive phases of tectonic phases of the Albian stage are ascertained in the interval between the middle Eocene and Neogene. At this time gentle arch-like uplefts formed and the main movements took place in the Bandibaba and Bavindar zones of fractures, predetermined the final tectonic appearance of the region. The following movements were considerably less intensive and manifested locally as shifts only along some rupture dislocations.

Folding and rupture structures different phases of tectonic movements, are described in the studied territory for the first time.

As a result of the works a characterist typical inheritedness is ascertained in the direction of folding and rupture structures/ sublatitudinal/, beginning with Paleozoic up to present, which is connected with the region position in the narrow zone of earlier Alpine /Cimmerian/ geosyncline, limited by the Karakum epihercynic platform from north and by the Iran-Afghan "medium massif" -from south.

4. As a result of the geomorphological studying different morphogenetic relief types are distinguished, their origin and age are clarified, the main stages of development of the region relief are ascertained.

5. As a result of conducting prospecting works and studying the manifestations of useful minerals , and coal in the first place, discovered and known before, the following was ascertained:

a/ coal manifestations are confined to two age complexes: the lower Carboniferous and the middle Jurassic, which are limitedly spread in the region.

b/The Palwan coal manifestation is connected with the lower Carboniferous coal-bearing complex. Because of its low quality, small reserves, complicated tectonic conditions and difficult economics, this coal manofestation is of no practical interest. The geological sketch map at a scale of 1:20000 is compiled for this area of the coal manifestation.

c/The Madjed-i-Chob-i deposit is connected with the middle Jurassic coal-bearing complex. These coals are of better quality/ gas, medium-metamorphosed/, lie in less complicated tectonic conditions. Due to heightened sulphurousness they are of limited interest for industry. They can be used with great effectiveness for energetic purposes. The deposit reserves are limited / about 3 mln tons/, but they can be increased as a result of conducting prospecting works, which are recommended to the "Customer" /see the section "Coal presence"/. The geological sketch map is compiled for the deposit region at a scale of 1:25000.

d/ as there are no other coal manifestations in the region, and the development of coal-bearing formations is limited, the region ,as a whole, is considered in relation of its further prospects for coal as non-perspective by us.According to the available structural and geological data further prospects for coal should be condusted east of the investigated region in the zone of earlier-Alpine geosynclinal trough and in the marginal parts of the platform sections, adjacent to it.

e/ from other useful minerals the following minerals were fixed in the region: manifestations of iron ores, copper manifestations, manifestations of phosphorites, deposits of limestones and marls, fit to cement production,[x]/ manifestations of gypsum, deposits of brisk earths and accumulations of pebbles and gritstones.

As a result of the carried out heavy concentrate sampling mechanical dispersion halos of such minerals as cinnabar, scheelite, gold, minerals of lead, rare earths and some others, which are of prospecting importance, were ascertained.

g/ As a result of the carried out prospecting works all the discovered and known before deposits and manifestations of useful minerals are shown on the map and the areas, whitin the limits of which conducting more detailed works on prospecting are recommended, are given: for coal / one area/for iron/ two sections/,for phosphorites /one area/, for cement raw materials/three sections/;besides the useful minerals, discovered in the heavy concentrates, are plotted on the mineral resources map, and their mechanical dispersion halos are shown,which can be used at projecting further prospecting works.

5.In the process of the geological survey underground shows / springs/ were fixed their connection with definite complexes of rocks and structures is ascertained. Chemism of underground waters was studied. Springs with heightened mineralization were exposed.

Underground shows are plotted on the mineral resources map due to their small number.

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x/ The manifestations of cement raw materials, discovered by us in the May of this year are given to the Chekoslovakian company, who are occupied in prospecting for and projecting the cement plant in the region of Herat,by the Ministry of Mines and Industries.

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EXPLANATIONS TO THE FIGURES AND PHOTOS,

ATTACHED TO THE RUSSIAN TEXT.

Fig. I. Location sketch of the investigated region /shaded/.

Fig. 2 Orohydrographic sketch.

Fig. 3. General view of the Karukh depression and the ridge Seelsela Koh-i-Band-i-Baba.
/ Photo by K. Mikhailoff/.

Fig. 4. Diagram of average monthly temperature and precipitations according to the data of the Herat meteo-station.

I- Temperature diagram. Conventional signs: I- absolutely maximum; 2-maximum; 3- average; 4- minimum;5 -absolutely minimum.

II- Precipitation deagram.

Fig. 5. Sketch of geological studying.

Explanation: I- reconnaissance investigation of the Madjed-i Chob-i coal deposit , D. Lemmon,1950; 2- route intersection, S. Tromp and S. Popoff, 1954; 3- reconnaissance investigation of the Palawan coal manifestation, the Chartaq and Madjed-i-Chob-i coal manifestations, P. Hammer, 1958; 4- geological syrvey, scale I:500000,Ju. Chepoff,and others,I96I; 5- geological survey, scale I:50000, S.Ivanoff and others, 1960; 6- point of compiling detailed stratigraphic section of Creataceous deposits,O.Cherkassof, 1960; 7- a boundary of the investigated area, scale I:200000, scale I:200000, 1964.

Fig. 6. Location sketch of places of compiling stratigraphic sections / in the numerator- sections Nos, mentioned in the report text; in the denominator- index, showing the age/.

Fig. 7. Comparison sketch of coal deposits sequences.

I- quartzy porphyries; 2- tuffs of quartzy porphyries; 3- phyllites; 4- basalt porphyrites; 5- limestones; 6- argillites; 7- aleurolites; 8- coal; 9- sandstones; IO- conglomerates; II- places of fauna finds.

Fig. 8. Comparison sketch of sequences of Permian deposits.

Explanation: I- conglomerates; 2- gritstones; 3- sandstones; 4- aleurolites; 5- limestones; 6- effusions; 7- tufogenic- sedimentary rocks.

Fig. 9. Comparison sketch of sequences of Triassic deposits.

Explanation: I- limestones; 2- argillites; 3- aleurolites; 4- sandstones; 5- conglomerates; 6- sandy limestones; 7- lavas of the andesitic composition; 8- tuff-lavas; 9- tuff argillites; IO- agglomeratic lavas; II- places of gathering fossil fauna; I2.- No in the location sketch of stratigraphic sections.

Fig. IO. Comparison sketch of sequences of Middle Jurassic deposits of the central and north-western areas of the Madjed-i- Chob-i coal deposit./ Phythms are given in Roman numerals/.

Explanation: I- weathered coal; 2- argillites, coaly; 3- argillites; 4- aleurolites; 5- coaly aleurolites; 6- sandstones; 7- gritstones; 8- conglomerates; 9- tufogenic sandstones.

Fig. II. Summary stratigraphic section of the Cretaceous deposits of the ridge Selsela Koh-i-Band-i-Baba and the Laman basin.

Fig. I2. Limestones of the Albian stage in the Laman basin near the Pass Kotal-i-Sabzak./ Photo by K. Mikhailoff/.

Fig. I3. Oolitic limestone of the Albian age.Microphoto,enlargement x 22,nicols II.

Fig. I4. Comparison sketch of the deposits of the albian stage.
Conventional signs: I-limestones; 2-oolitic limestones; 3-detritic limestones; 4-sandy limestones, 5-ergillaceous limestones;6-marls; 7-clays; 8-sandstones; 9-conglomerates.

Fig.I5 Unconformability of Albian deposits on the deposits of the Chaheq suite of the lower section of Triassic in the upper course of the Darakht-i-Tut river.

Fig. I6/ Limestones of the Turonian stage in the Laman basin near the pass Kotal-i Sabzak . /Photo by K. Mikhailoff/.

Fig. I7. Comparison sketch of the sequences of the upper part of the Maastrichtian and Danian deposits / Cr_2ms + d/.

Explanation: I- conglomerates; 2- sandstones; 3- aleurolites; 4-clays; 5- sandy clays; 6 gypsum; 7- marls; 8- limestones; 9- sandy limestones; I0- red rocks.

Fig. I8. Superposition of the red minerals of the minerals of the upper part of the Maastrichtian and Danian stages / Cr_2 ms +d/ on the marls of the lower part of the Maastrichtian stage /Cr_2m_I/. The watersheds are armoured by a bed of sa sandy limestones of Paleocene / /. The Laman basin near the settlement of Laman .

/ Photo by K. Mikhailoff /.

20 Fig. 20.

Fig. 19. Cut -off of different levels of the Cenomanian, Turonian and Senonian stages by Maastrichtian red deposits. The Gurge valley./ Plan- sketch from the aero-photo by V. Kolchanoff/.
Conventional signs: I- sandstone, 2- clay; 3- marl; 4- limestone; 5- rupture dislocations.

Fig. 20. Summary stratigraphic section of the Paleogene deposits of the ridge Selsela Koh-i-Band-i-Baba and the Darya-i-Gala-Chagar basin.

Fig. 21. Comparison sketch of the sequences of the Galachagar suite of the Turkestan stage.
Conventional signs: I- basalts and hyalobasalts; 2-agglomeratic lavas and lava-breccias of basalts; 3- andesites; 4- trachytes/ albitophyres/; 5- tuffs of andesites; 6- tuffs of trachytes; 7- tufogenic conglomerates; 8-tufogenic sandstones; 9- aleurolites; IO- argillites; II- sandstones; I2- conglomerates; I3- clays; I4 - marls.

Fig. 22. Superposition of effusive-pyroclastic rocks of the Galagar suite /Pg_2^3 gl/ on the Tagaurabat suite /Pg_2^3 tg/. The upper reaches of the Darakh-i-Chortaq valley. / Photo by K. Mikhailoff/.

Fig. 23. Lava-breccia of basalts. The Galachagar suite. The upper part of the Darakht-i-Tut. /Photo by K. Mikhailoff/.

Fig. 24. Correlation sketch of Quaternary deposits.
Conventional signs:I- pre-Quaternary / bedrocks/. 2- moraines;3- rock-waste-block talus; 4- conglomerates and sandstones; 5- chemogenic limestones;6 -loesses and loess-like loams; 7- rock waste loams; 8- conglomerates, sandy loams; 9-pebbles, cobble round stones, sands, sandy loams. The complex of low terraces:0-flood plain; I- the first terrace above the flood plain; II- the second terrace above the flood plain. The complex of middle terraces; III- the third terrace above the flood plain;IV- the fourth terrace above the flood plain; the complex of high terraces: V- the fifth terrace above the flood plain.

Fig. 25. The structure of " the calcareous crust". the Darrakh-i-Chortaq valley. /Sketches by K. Mikhailoff/.
Conventional signs: I- the zone of leaching / loose/; 2- the zone of growth / compact/.

Fig. 26. Alluvial terrace ,25 m high /al Q_3/ ,superimposed to proluvial-alluvail-lacustrine deposits / pl-al-l Q_2/. The lower course of the Darakht-i-Tut. / Photo by K. Mikhailoff/.

Fig. 27. Location sketch of intrusive rocks.
Massifs: I-Dalantu; II-Tagau;III-Marghozor;IV-Rodimaluma;V-Karukh.
Conventional signs: I-the first phase / diorites/;2- the second phase - /plagiogranites/.3-the third phase / biotitic granites/; 4-the fourth phase /alaskitic granites/.

Fig. 28. Diorite. Dalantu massif,enlargement x 22, nicol +.
Pl=plagioclase;Bi- biotite; R- ore mineral; Am - amphibole.

Fig. 29. Plagioclase granite. The Togau massif. Enlargement x 22, nicols +.
Pl- oligoclase; Q- quartz; Bi- biotite.

Fig. 30. The Rodimaluma massif of biotitic porphyry-like granites in the ridge Selsela Koh-i-Dawindar /Photo by B.Pashkoff/.

Fig. 3I. Biotitic porphyry-like granite.The Rodimaluma massif. Enlargement x22;nicols+/. Pl-plagioclase;Bi-biotite;K-potassium feld spar;Q-quartz.

Fig. 32. Sketch tectonic map of sheet parts I-4I-IX,-X,-XV,-XVII / the Herat province/. Scale I:300000. Compiled by K.Mikhailoff./Explanations are given on the following page/.

Fig. 33. Folding mode in the coal deposits of the Palawan /C_1 pl/ and Sangizard /C_2 sn/ suites. The region of the settlement Pahlawanha. /Sketch by. B. Pashkoff/.

Fig. 34. Folding mode in Permian red deposits. The region of the pass Kotal-i-Zarmast. /Photo by K .Mikhailoff/.

Fig. 35. Mode of near-rupture pre-Albian folding in Triassic and Jurassic deposits.The south-eastern area of the Madjed-i-Chob-i coal deposit. / Sketch by K. Mikhailoff/.

Fig. 36. Mode of near-rupture folding in the upper Cretaceous and Paleogene deposits. The southern versant of the Selsela Koh-i-Band-i-Baba, the upper course of the Rod-i-Darakht-i-Tut r. /Sketch by V.Kolchanoff/.

Fig. 37. Mode of near-rupture folding in Permian red minerals, overthrust on the Cretaceous ones. The Dalantu valley, the southern versant of the Selsela Koh-i-Band-i-Baba. /Sketch by V. Kolchanoff/.

Fig. 38. Mode of folding of the Suzak and Alaian /Pg_2^2 a/ deposits, the mountain Koh-i-Pirakka, the right bank of the Tagab-i-Mohammad Khan. /Sketch by V. Kolchanoff/.

Fig. 39.Relief of the Bandibaba sequence and near-rupture folding in Triassic and Cretaceous deposits in the axial part of the ridge Selsela Koh-i-Band-i-Baba, near the pass Kotal-i-Ustur Murda. /Sketch by k. Mikhailoff/.

Fig. 40. Character of small overthrusts, conjugated with the Band-i-Baba rupture, and near rupture folding in the upper course of the Darra-i-Chartaq. / Sketch by K. Mikhailoff/.

Fig. 4I. Recent middle-upper Quaternary rupture in proluvial-alluvial-lacustrine deposits in the region of the settlement Benosh -Darra. /Sketch by K. Mikhailoff/.

Fig. 42. Recent rupture, due to which a bench formed in the valley riverbed. / Photo by K. Mikhailoff/.

Fig. 43. Geomorphological map of sheet parts I-4I-IX,-X,-XV,-XVII / the Herat province/. Scale I:300000. Compiled by K. Mikhailoff. /Explanation is on the following page/

Fig. 44. Erosive-tectonic medium-mountain steep-sloped relief /A_{Ia} Q_{I-4}/ ,formed on the rocks of Middle Paleozoic /P_2 c/. The eastern versant of the Selsela Koh-i-Dawindar. Aerophoto No.5826, scale I:60000.

Fig. 45. Erosive-tectonic medium-mountain steep-sloped rocky relief /A_{Ic} Q_{I-4}/, formed on the porphyry-like boundaries. The eastern versant of the ridge Selsela Koh-i-Dawindar. Aerophoto No. 217733, scale I:60000.

Fig. 46. Erosive- tectonic medium-mountain steep-sloped relief /A_{Ia} Q_{I-4}/, formed on the rocks of the Permian age near the settlement Madjed-i-Chob-i.
/Photo by K. Mikhailoff/.

Fig. 47. Denudative-erosive-tectonic stepped relief of slopes /C_{Ia}/ ,formed on the bedd gently lying rocks of Cretaceous-Paleogene / the right part of the photo/;flat tened structural-denudative relief of the medium-mountain stepped plateau and rare table mountains / C_{Ib}/, formed on the rocks of Paleogene / the left part the photo/.
The upper reaches of the right tributaries of the Darya-i-Tagab Laman .Aeropho No.9944, scale I:60000.

Fig. 48. Flattened structural-denudative relief of the medium-mountain structural pl plateau and rare table mountains / C_{Ia}/, formed on the rocks of Paleogene. T Watershed of the ridge Selsela Koh-i-Band-i-Baba , in the western part of t region. /Photo by K. Mikhailoff/.

Fig. 49. Denudative- accumulative relief. A proluvial-alluvial-lacustrine plain, cut by the Bod-i-Karukh valley /D_{Ie} Q_4/- the right side of the photo. A proluvia submontane plain /D_{Ib} Q_{3-4}/- the left side of the photo, the Karukh depressi west of the settlement Armalik. Aerophoto No. 5962, scale I:60000.

Fig. 50. An accumulative proluvial-alluvial- lacustrine plain, transforming into a pro luvial-talus, middle Quaternary plain. The southern versant of the Band-i-Ba gisat, near the pass Kotal-i-Sabzak.
/Photo by K. Mikhailoff/.

Fig. 5I. A rupture dislocation in middle Quaternary proluvial-alluvial-lacustrine dep sits /pl-al-l Q_2/, seen in the relief as a bench. The region north of the settlement Dalantu. Aerophoto No. 5983, scale I:60000.

Fig. 52. Erosive- tectonic low- mountain monticulate-ridgy relief / A_2bQ_3/, formed on loesses and Neogene deposits. The region of the middle course of the Darya-i-Gala-Chagar. Aerophoto No. I773I, scale I:60000.

Fig. 53. Erosive- tectonic low-mountain finely rugged relief of the type "bad land", formed on terrigene red deposits of the Turkestan stage. The region ,south of the settlement Karukh. Aerophoto No. 5835, scale I:60000.

Fig. 54. Geological sketch map of the Palawan coal deposit, compiled by V.Kulakoff. Conventional signs: I- Quaternary system, recent section; alluvial deposits- coarse gravels, sands; 2-Quaternary system, middle section, proluvium-alluvi conglomerates, sandstones, gritstones; 3-Permian system- red sandstones, co merates, argillites; 4- Carboniferous system, middle section,Sangizard suit limestones, sandstones;5- Carboniferous system, lower section,Palawan suite- argillites, sandstones, limestones, coal seams; 6-coal seams; 7-trench and number; 8-old working; 9- a boundary of normal stratigraphic contact; IO- a boundary of deposits unconformability; II- rupture dislocations: a/known, b/ inferred; I2- strike and dip; I3- Lines of geological sections;I4-areas numbers; I5- limestones; I6- argillites; I7- Aleurolites; I8- sandstones; I 19- conglomerates; 20-coal; 2I- fossil fauna sample sections.

Fig. 55. Columns of coal seams of the Palawan manifestation with showing sample se tions. Sections numbers are shown with Roman numerals.

Fig. 56. The south-eastern /I/ and central /2/ areas of the Madjed-i-Chob-i coal dep sit. View from south. A basal seam of the Albian stage is seen as a cornice.
/Photo by K. Mikhailoff/.

Fig. 57. Plan and vertical projection of the exploited underground workings in the south- eastern section of the Hadjed-i-Chob-i deposit. The structure of the coal seam and sample sections are shown in columns.

Fig. 58. The north-western section of the Hadjed-i-Chob-i deposit. View from south. Location of old workings is marked off with crosses.
/ Photo by K. Mikhailoff/.