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R E P O R T

on geological-surveying works of
1:200 000 scale in the coal-bearing
regions of the North-eastern Afghanistan.
Map sheets:222-C,502-D,503-B;
parts of map sheets:22I-F,222-D,222-F,
502-A,502-B,502-C,502-F,503-A,503-C,
503-D,503-E,504-A,

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Volume I - Text

Part I,II

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V/O " TECHNOEXPORT"
Contracts No.No. 640,I378

ROYAL AFGHAN GOVERNMENT
MINISTRY OF MINES AND INDUSTRIES
DEPARTMENT OF GEOLOGY AND MINES

K.Ja. Mikhailov,V.P.Kolchanov,V.V.Kulakov,
B.R.Pashkov,B.N.Androsov,M.A.Chalian.

R E P O R T

on geological-surveying works of I:200 000 scale in the coal-bearing regions of the North-eastern Afghanistan. Map sheets: 222-C,502-D,503-B; parts of map sheets:22I-F,222-D,222-F, 502-A,502-B,502-C,502-F,503-A,503-C, 503-D,503-E,504-A.

Volume I - Text
Part I, II

President of the Departament
of Geology and Mines of
Royal Afghan Government
S.Mirzad

Chief specialist of
V/O "Technoexport" of
the USSR
A.Ja.Kotov.

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

The geological-surveying works of I:200 000 scale in the coal-bearing regions of the North-Eastern Afghanistan had been carried out in accordance with the contracts No. 640 from 22 nd of October I962 and No. I378 from 20 th of December I965,concluded between the All-Union export-import union of the USSR ("Technoexport") and the Ministry of Mines and Industries of Afghanistan on the grounds of the agreement between the USSR and the Royal Afghanistan from I6 th of October I96I.

By the mentioned contracts the rendering of technical assistance in the " carring out of the geological survey of I:200 000 scale" was foreseened.

The area of geological survey in the North-Eastern Afghanistan (fig.7,Russian text) was at first designed by the Department of Geology and Mines at the Ministry of Mines and Industries of the Royal Afghanistan. The area is located at the northern and north-western slopes of the Hidukush range and partly at it's piedmonts,involving the areas of the Samanhan,Bamian,Kunduz and Takchar provinces. The nomenclature of the maps of I:I00 000 scale is as follows : 22I-G, 222-C,-D,-E,-P; 502-A,-B,-C,-D,-P; 503-A,-B,-C,-D,-E; 504-A.

When determining the limits of this area the Department of Geology and Mines had followed the general information only on the presence in it's limits of coaly deposits such as Dakhani-Tor,Shabashek,Kara-Kotal,Ishpushta,Barfakh,Karkar,Nakhrin,Tch al and Zamburak.

By the Department of Geology and Mines in I963 the Project of works on the carring out of geological survey was drawn up and which was affirmed by the authority of the Department. In accordance with this project during I963-I965 y.y. a construction of the geological map on the designed area in the scale of I:200 000 as well as the receiving of another necessary materials which would serve in the future "as a base for carring out of purposefulness and effective searches of raw materials" and firstly for hard coal of coking sorts was supposed. In the process of geological survey the boundary of the works area,volumes and some methodical moments were specificated by the additions to the main project,which were annualy affirmed by the President of the Department,that is in I964 and in I965.

The volumes of the carried out during I963,I964 and I965 field works are given in the following below table:

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No.NO. in sucess.	Kinds of field works	Unit of mesure	Fulfiled volumes by years			Total
			I963	I965	I965	
I.	Geological survey of I:200 000 scale	km^2	8000	4000[x]	2300	I4300
2.	Heavy concentrate sampling	sample	733	II05	220	2058
3.	Spectral sampling	-"-	I250	I400	300	2950
4.	Chemical sampling	-"-	202	I45	55	402 (including 50% for coal)
5.	Hydrochemical sampling	-"-	8I	62	I5	I58
6.	Mining works	m^3	660	490	60	I2I0

x- During the same year besides the mentioned volume the area of 3400 sq,km. in the region of Herat was covered by mapping works. The geological report on this work was provided in I965 (by Mikhailov K.V. Kulakov V.V.,Kolchanov V.P.,and others, I965).

A large part of the area was not supplyed by any of topographical base. In connection with this the geological-syrveying works during I963 and I964 were carried out exclusively on the aeral photoes of I:4 0000 - 60000 scale. From the autumn of I964 when the topomaps had been received[x)], the compilation of the geological and other maps was begun with the help of transfering of the geological data from the aeral photoes on these maps. It required much of additional time and put the terms of the final geological maps transmission back,as well as the geological reports;all this was foreseened by the contract No.I378.

The works of I965 were completely supplyed by the topographical base of the Soviet production in the scale of I:I00 000 as well as by photomaterials of I:30 000 - 50 000 scale. The quality of the topographical base and the photomaterials is satisfactory. In connection with the absence for the large part of the area of a ready topographical base of I:200 000 scale and in accordance to the agreement of the Department of Geology and Mines,the final report geological map,supplied

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to the present report is compiled on the topographical base of the I:100 000 scale,which was prepared with the help of transformation of the maps of I:50 000 scale. Judged by it's geological amount of details this map is corresponding to the scale of I:200 000,which was foreseened by the mentioned above contracts and the project.

In the present report the questions on the geological structure of the studied territory are elucidated,ore manifestations and deposits of raw materials are described,the perspective valuations of the regions conserning their coal-bearing,xxxx,and others raw materials are given, the areas for the further more detail prospecting-exploration works, and firstly for hard coal are marked.

The works during first two years were carried out by two geological-surveying parties. From the side of the Soviet side the staff of specialists was the following: technical leader-K.Ya.Mikhailov, engineers-geologists - B.R.Pashkov,A.I.Gorelov, V.M.Kotov and A.G.Gumerov. From the side of the Afghan specialists - Makhmud-Khan,engineer-geologists: Munchezada,Rustami Shafi and Naki;collectors-Abduraim,Usman and Izmail.

The territory being under investigation is characterized by different degree of outcropping. The western,Central and south-eastern parts of it,occupying up to 75% of the area,are well outcropped. The north-eastern part,lolongated by a strip from the Farkhar river up to the mountains of Pul-i-Khumri,along the north-eastern boundary of the territory,are distinctive for the poor outcropping.

The thickness of loose deposits,represented on the interstream areas by loeses and loese-like loams and in the valleys of waterchannel by alluvial and alluvial-proluvial deposits,ranging from first up to 20-25 meters.

By the complication of the geological and geomorphological structure the region is not equivalent. The most part of it (60%) has a very complicated geological structure,the less part of it (20%)- by complicated and simple(20%).

By the interpretation of the aerial photoes the area is subdivided into three parts: with good interpretation (60%),with medium (20%) and with bad - (20%).Practicability is different: on the most part of the territory (60%) is medium,on less part of the territory (20%) is bad and good-20%.

Geological-surveying and search works had a complex character as for the applied methods (routes by the territory across the strike of the rocks and partly tracing of the contacts,heavy consentrate,

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metalometric,hydrochemical sampling)so as for it's aim (geological survey,search for all the kinds of useful raw materials,and first of all for hard coal,geomorphological and hydrogeological observations). Depth of the geological mapping of the investigated territory in the main is characterized by the summary thickness of the section being 28 000 meters,involving an interval of age from the Proterozoic up to Recent deposits.

The routing as in the main was carried out on horses,partly on car and om foot. The total extent of the routs amounted more than 8,4 th.km or 0,59 linear km. for I sq.km. of the area;total amount of the observation points is 9813 or 0,68 for I sq.km. of the area.

The main attention was payed to the manifestations of hard coal and of coal-bearing areas. On the areas which were perspective from the point of view of coal-bearing the network of the routes and observation points was densed and reached I,I 1.km of a route for I sq.km. of the area and I,5 of observation point for I sq.km. of area,by this a quite reliability of the searching works was provided.

Total effectiveness of the search works is determined by the following figures: I20 manifestations and deposits of hard coal and other raw materials have been discovered,28 areas,perspective for the detailed purposeful searching and search-exploration works for different kinds of raw materials have been designed. Out from the number of the most considerable deposits for coal,dimcovered in the process of the geological survey,the following could be mentioned: the Lela,Harmak western and the Harmak eastern, Karamkul,Sary-Assia,Roshah,Kiashakton,Namakab, etc.

I7 perspective areas for the setting up of more detailed search-exploration works for hard coal have been designed;on some of them as far back as in I965-66 the geological-exploration works had been carried out.

In the laboratory works as well as in the drawn up of chapters and sections of the present report took part the following specialists: K.Ya. Mikhailov,N.P.Kolchanov,B.R. Pashkov,V.V. Kulakov, M.A. Chalyan, B.N.Androsov,V.V. Kurennoi,V.N.Nesterov, A.I.Gorelov and V.M.Kotov.

Different kinds of determining works were carried out in the complex laboratory of the Department of Geology and Mines at the Ministry of Mines and Industried in Kabul city and partly in the USSR.

In the complex laboratory of the Department of Geology and Mines the following kinds of analitical and determining works had been car-

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ried out under the leadership of the chief of the laboratory Mr. Nizamudin Khan and the technical leader of it I.I. Malkov:

- Coaly-petrographical investigations: V.N.Nesterov,M.A. Marshanskaya (Kabul city);

- Petrographical determinations of thin sections: I.A.Efimov, M.A. Bogomolov (Kabul city);

- Mineralogical analyses of heavy concentrates: V.A. Narodnaya, E.I. Mikhailova,M.N.Khasanova (Kabul city);

- Chemical analyses (silicate ones for different raw materials and for water): G.P.Sinjugina,P.T.Juschenko,I.B.Kondratieva,M.I.Scherbina, A.N.Trofimova,M.P.Zhukova, Mr.Mr. Abdel-Vakil,Makhammad-Osef, Makhammad-Junus,Shafika (Abdul Raim),Hulalai (Borad Ali) Kabul city;

- Technical analyses of hard coal: L.M.Andreeva;

- Spectral analyses: Ju.M.Skaller,Saradzhaddin,Azis (Kabul city);

- Determinations of fossiles of flora: T.A.Sixtel and N.M.Loseva (Tashkent city,the USSR);

- Determinations of fossils of fauna: B.K.Kushlian,A.A.Shevyrev, M.V.Shevchenko,N.V.Litvinovich,I.V.Pyzhianov,V.V.Druschits, E.Ya.Leven, A.S.Dagis,V.L.Lelishus,S.S.Karapetov,G.P.Kreidenkov,Z.Z.Muftiev, G.N. Grinenko,A.I.Lavrusevich, M.Dzhalilov, D. Buzurukov, T.F.Andreeva, E.Egorov, V.V.Kurbatov,N.V.Kabakovich, T.A. Dobrolubova, I.I.Chudinova, A.Ya. Frolenkova, (Moscow,Tashkent,Dyushanbe,the USSR), V.I. Kuznetsov E.Shats (Mazar-i-Sherif,Afghanistan).

- The drawing in the text and in the appendixes is designed by A.P.Vasiliev,R.A.Vasilieva,G.A.Chyutkov,A.A.Chyudnova, A.I.Pleshkova, Tashkulat Rakhmanov,Abdul Udyud,Anor Hul,Abdul Kajum,Abdyul Razok (Kabul city);

- Photo works were carried out by D.P.Chmyutov (Kabul city);

- The maps are printed in the Cartographical Institute of Afghanistan in Kabul city.

General leadership by the laboratory and field works was directed by the President of the Department of Geology and Mines Mr. S.H.Mirzad and by chief specialists O.A.Manyuchariyants and A.Ya.Kotov,by chief geologists Ju.N. Lavrov and V.I.Kolesnikov.

The authors of the present report are expressing their deep acknowledgement to all the mentioned above persons for their help,for the taking part in this work and for valuable suggestions.

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Chapter I

PHYSICO-GEOGRAPHICAL ASSAY

Relief. The region of the carried out works involves the northern slope and the piedmonts of the western Hindukush (from the administrative viewpoint-the parts of the Bamian,Bahlan,Samanhan,Kunduz and Takkhar provinces). From the orographical point of view the region is representing by itself a middle-height reliefed area with absolute elevations rarely exceeding 4000 meters.

The main orographical unit in the western part of the area is the Farand ridge (the eastern continuation of the Tirbandi-Turkestan ridge). It consists of several echelon-like ridges of sub-latitudinal direction. The length of this chain of mountains within the limits of the area is nearly to I50 km. The absolute marks range from 3000 up to 4000 meters. The highest mark being 4098 meters is located at the eastern part of the ridge at the up-streams of the Kaion,Aokhorak,Doabi-Shakhpasand rivers. The ridge itself is lowering to the East and at the interstream area of the Larkhob and Andarab rivers it's height does not exceed 2900 meters.

The mountain relief of this part of the territory is somewhat different to the rest part of the region. The mountain slopes here are steep the ridges are narrow,saw-like. The cuesta relief and the relief of "bad lands" are not widely developed. Within the limits of the Farand ridge considerable relative elevations up to I600 m. (in average for the region they amount 700 m.) are characteristic.

Quite another relief character is in the north-western part of the region (fig.I). The spurs of the Farand ridge gradually lowering to the North are transforming into hilly plain,located already off the limits of the works area. The main direction of the ridges is north-western one rarely it is north-eastern. In the far West of the area the mountains of Kuli-Karham and Kukhi-Khasani (the spurs of the Kukhi-Hisar) are lolongated in the meridional direction,with the highest mark being 3470 meters. The absolute marks in this part of the region are somewhat lower,than in the South and in the Centre of the area. Usually they amount 2500-3000m. Relative elevations are not more than I000 meters. The hilly-spurry surface of the interstream areas of rivers and ridges are not compleately characterizing the relief of this area. Rivers valleys of specific form are imparting an originallity to it. More often they are fissures with vertical slopes,elevating above narrow (up to I00 m.) watercourse of river for 200-300 meters. The areas of the valleys are mat,the upper part of which slopes are represented by fragments of cuestae,and the lower ones- are gentle,sometimes are step-like. The valleys with gentle slopes

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are less characteristic.

The Central part of the region, to the North from the town of Pul-i-Khumri is representing by itself a relatively lowered area with the absolute marks being in average nearly to I200 m. and with relative elevations not more than 600 m. The apex of mountains are elevating here above the hilli-spurry surface. Cuesta-like and reviney relief types are developed here(fig.2). The higherst mark is I862 m. and it is located in the Central part of the Kukhi-Shekh-Jalal ridge, lolongated in meridional direction and limiting the Baglan oasis from the East. In some distance to the North of it the latitudinal ridge of Kukhi-Akhman-Kamar (the most high mark I574 m.) is located.

In the far north-eastern part of the region into the limits of the studied region come the meridionally oriented northen spursof the western Hindukush, with the absolute marks up to 3500 m.(fig.3). From the West to them the lolongated to the Norht-East for 70 km. from the settlement of Nakhri up to the Kotali-Chal pass the Ishkamysh depression is adjacent. The depression is representing by itself a plain with the elevations of I000-I200 meters and is limited from the West and from the North by the area of hilly-spurry relief with the elevations being not more than I800m

T h e r i v e r s of the region are related to the basin of the Amyu-Dariya river, being left tributaries of it. Directly into the Amyu-Dariya the only Surkhab river is falling (at the downstream of the Kunduz river is falling into it). The rest of the rivers are lost within the limits of the Northern Afghan depression, located beyond the limits of the investigated territory. The main amount of humidity the rivers receive at the expence of atmospheric presipitations: spring and glacial waters have a subordinate significance. The discharge of the rivers is not constant during different seasons, respectively to it. Abounding in water during the winter-spring period, large rivers during the summer period are becoming shallow, small ones are dried-up almost on the whole their extent Most part of the waterchannels is periodical and episodic one. As an exception is the Farkhar river, feeding as in the main at the expence of glaciers melting as well as snow covers, located at it's up-streams beyond the limits of the investigated region, as well as at the expence of an underground drainage. The discharge of the water in this river reaches it's maximal maltitude during the summer months (July-August), the minimal one-during winter.

The whole rivers' net is related to the basins of the Surkhab, Farkhar, (Khanabad), Darra-i-Suf and Khulm rivers.

The Surkhab river is the main water artery. It's length within the

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limits of the investigated territory is nearly 250 km.(fig.4). The Surkhab river namely begins near the settlement of Doabi-Mekhzarin,were three rivers of Bamian,Saigan and Kamari flow together. Their up-streams are located beyond the limits of the investigated region at the northern slopes of the Baba ridge. At it's up-streams the Bamian river is flowing from the South-West to the North-East along the deep Shikarii gorge. The meandering watercourse of the river has the width here being I00--200 meters and above it steep,sometimes vertical slopes of a ravine-like valley are elevating. At the low-coarse of the valley (from the settlement of Doshi up to the town of Pul-i-Khum ri) the river is named as Pul-i-Khumri,downstream it as Bahlan,and from the town of Kunduz -as Kunduz. The width of the valley reaches several kilometers. The river here is meandering,often changing the watercourse. By it's water the cotton and sugar plantations of the Bahlan oasis are irrigating. The most large tributaries of it,with the exception of the mentioned Bamian,Saihan and Kamarda are the following: left ones the Lorank,Ishpushta,Vodu,Turmush, Kaion,Dakhana;the right ones-the Ashraf,Andarab,Lakhrob,Nakhrin,Farkhar (Khanabad) with the tributaries of Namakab and Chal.

On the Surkhab river several electric power stations with the total power capacity being nearly to I5 000 kilowatt, have been built.

At the northen slopes of the Farand ridge the rivers forming the basin of the Darra-i-Suf and Khulm rivers,are taking their beginning. Their down-streams are situated beyond the limits of the investigated territory.

The Darra-i-Suf river takes it's beginning after the confluence of the Khaus,Chikhil-Dukhtaran,Chakhar-Dekh and Shorab rivers. The most abounding of water from them is the Char-Dekh river. The most large tributaries of the Khulm river are the Andarakh,Doab rivers(the latter is the most abounding of water). The rivers of Darra-i-Suf and Khulm as well as their main tributaries are constantly water-bearing. The appearence of their valleys is also alike. Deeply cut in,often narrow and meandering they have the width of the bottom which does not exceed I00-200 meters.

L a k e s. Some lakes of glacier origin with the area of from I00 up to 0,5 sq,km. are located at the up-stream of the Aokhorak river and near the settlement of Sary-Assiya,at the up-streams of the Lela river.

C l i m a t e as in the main of the whole territory is sharply continental one. Relatively elevated regions are singled out,with the climate of mountain deserts and semideserts,as well as lowered regions-with dry steppeous and semiarid climate. For the mountain regions the

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positive average annual temperature is characteristic, by this fact the absence of glaciers within the limits of the investigated territory is explained. Inspite of this the winter here is prolonged and severe one[x]. Average temperature in January is -I4°C. Summer is short and dry..The average temperature in July is +8,7°C. July is the most dry month in a year: the relative humidity of an air is decreasing during this time up to 44, the average annual being 66. During a year in these regions up to 300 mm. of precipitations are falling down, including in the form of snow-the main part: out from I50 days in a year with precipitations for snow are I20 days.

For the northern and north-eastern parts of the area of the works the average annual temperature is also positive, but the average temperature of January is lower-near 0°C (fig.5). The winter here is shorter and milder. The minimal average temperature of January not lower than -9°C. Dry and hot summer lasts for 6 months. Average temperature of July amounts +29°C., maximal one reaches + 4I°C. Annual amount of precipitations is 300 mm., the main their quantity precipitates in the form of rain (fig.6). Out from 55 days in a year 52 days fall on rain. The annual relative humidity of the air is 65, the minimal one is 52-44 and observed in July-September months.

V e g e t a t i o n. The vegetation is steppy and desert and does not distinguished by difference. Ridges at the altitudes of I500-4000 m are covered by steppy grass and bushes. Prickly growing in dry climate conditions bushes are widely distributed. Forests are present on very limited areas, mainly at the northern slopes of mountains. Forests are represented by sparse growth of trees of pistachio, archae and hawthorn, Busheous vegetation has a limited development and is represented by wild cherries, sweetbrier, barbarries. By the valleys of the rivers single poplars, willows, wild pear-trees, and apple-trees. At the plain part of the territory a desert vegetation is the predominant one, represented by wormwood, saline, camel prickle, tamarisk, etc. In irrigated oasises-there are gardens, vineyards, sowings of cotton-plants, grainy farmings, groves of mulberry-trees.

E c o n o m i c s a n d p o p u l a t i o n. Within the limits of the studied territory two towns are situated. Bahlan-the administrative center of of the same name province, the center of sugar and textile industry, and Pul-i-Khumri - in it a textile factory is located; the cement plant, electric power station and small handycraft enterprises are also concentrated here. The number of inhabitants here are as respectively 30 and I5 thousand people. On the territory of the investigated area

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a number of important exploitating or preparing to the exploitation of coaly deposits is found: the Dakhani-Top,Shabashek,Sary-Assiya, Ishpushta,Karkur and Dudkash. Besides it the exploitation of rock salt is present here-the Namakab (Takcha Khana),etc.

The main mass of the inhabitans is living in kishlaks,located by the rivers' valleys at the altitudes of up to 3000 meters. The most large of them are the following: The Rui,Madr,Doab,Tatar,Nakhrin,Fulul Ishkamysh,Chal,Takcha Khana,etc. The main employment of thesettled pop population is agriculture and cattle-breeding.

The national composition is quite mixed: Afghan, Tajik,Uzbek, Turkmen,Tatars,Khazarey,etc.

M e a n s o f c o m u n i c a t i o n. The main transport highway within the limits of the investigated area is the automobile road running by the valleys of the Bamian and Surkhab rivers. It is the part of the transhindukush tract,which was up to recent time (final of the Salanh tunnel construction works) as a main transport line here. It was a single functioning the hole year round road,connecting the northern parts of the contry(via the pass Shibar 2987m.) with southern ones. From the settlement of Doaby-Mekhzarin up to the village of Doshi the road has a gravel cover,being in satisfactory condition; further to the North to the towns of Pul-i-Khumri,Bahlan,Kunduz it is covered by asphalt. There are several branches from the main road: near the settlement of Doabi-Mekhzari-by the valley of the Saihan river (30 km.);along the valley of the Kamard river and along it's tributary(nearly 55 km.);to the settlement of Mard (IO km); I2 km. up-strea the Surkhab river from the settlement of Doshi-by the valley of Kaion river(I8 km.);from the Pul-i-Khumri town up to the settlement of Dakha na (25 km.).Besides all this,fom the tract connecting the Pul-i-Khumri and the Mazari towns (it runs somewhat to the North from the investigated territory) several automobile natural soil roads are coming out; by the valley of the Darra-i-Suf river up to the settlement of Shabash ek (25 km.);by the valley of the Chakhar-Dekh river up to the settlement of Dakhani-Tor (20 km. within the limits of the works area);by th Siyakh-Darra river,beginning to the South of the Pul-i-Khumri town; from the town of Bahlan up to the settlement of Nakhrin,between the settlements of Ishkamysh and Nakhrin;from the town of Pul-i-Khumri to the coaly deposits of Karkar and Dudkash. Besides it,nearly 30 years ago parallel to the packroad,connecting the settlements of Rui and Doabi-Shakhpasand,the construction of automobile road had been begun. Some parts of it have been constructed,but at the present time they ar

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in neglected condition,and are not used. Side by side with the mentioned automobile roads there are number of pack,foot-paths and cattle paths.

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Chapter II.

GEOLOGICAL NOTION ON THE REGION OF WORKS

The investigated region is lolongated in the North-Eastern direction by the northern slope and by the piedmonts of the western Hindukush (fig.7). It involves the coal-bearing regions,which are as a main for the first time have been subjected to geological survey. Some parts of this territory had been studied before also. Out from the early investigations the works carried out by K.L.Grisbakh (I886) and by G,G. Gaiden (I9II) should be mentioned firstly. Their works serve as a summary on the vast areas and are of some interest even at the present time. Geological observations had been carried out by R.Fisher(I926,I94I),by K. Brjukl (I935)as well as by several other investigatours during the 20 th and 30 th years of the XXth century.

In connection with the efforts undertook by the Royal Afghan Government on the exploitation of the raw materials of the country from the end of the 30 th years of the XX th century a number of investigators are studing the coal-bearing areasns within the limits of the region under consideration. One of the most interesting summaries on the coal deposits was comiled by V.D.West (I942). Analogical works had been continued during the further years also. Involving as a main the adjacent territorie they are of interest from the viewpoint of preparation of general scheme on the stratigraphy and on the investigation of the geological development history of the country.

The geological investigations in a considerable degree had become regulated after the creation of the Geological Service of Afghanistan in I955 and after further expantion of the geological enterprizes net in I963. The carried out during this time works (Bratash V.I. and others I96I; Khatiskati G.N. and others,I963;D.Vaippert,I964; K.Khintse,I964, etc.) are providing a more complete notion on the structure of several regions,creating the basement for the planning and direction of the different kinds of mineral raw materials' searchings.

Below in a chronological sequence the most important results of the works are given,which have been received by different investigators in the process of studing of the areas of the Northern Afghanistan,interested to us.

To K.L.Grisbakh (I886) we are obliged practically for the first information on the geology of the northern Afghanistan. By route crosses he investigated the Afghan Turkestan,from the ridge of Tirbandy-Turkestan in the North up to the ridge of Baba in the South,having involved the part of the investigated by us territory (fig.7). K.L.Grisbakh is

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supposing the scheme of the stratigraphy of the investigated by him area as follows (omitting the divisions and geographical denominations beyond the limits of the region investigated by us):

Age	Lithological characteristic	Region
I	2	3
Recent	Fine sands, alluvium, debris cones. Loess with interbeds of clays, sandstones and conglomerates	Everywhere
Pliocene	Conglomerates, light-red and purple sandstones; light-red and green clays, brown schistose clays with flora of Plinorbis sp., Helik sp.; veins of gypsum.	Valley of the Madr river.
Miocene Upper	Light schistose clays, clays, sandstones; deposits of deltae with fossils of fish, vegetation and crustaceans.	Valley of the Madr river.
Miocene Lower	Sandstones and dark clays (deposits of shelfs) with Cerithion sp.	-"-
Eocene?	Very dense light sandstones and sandy limestone	-"-
Upper	Chalk with silicon ; Inoceramus sp., Exogyra sp. and others abundunt Pelicipoda; Dense limestones with Exogyra sp.	To the North from the Saihan.
Jurassic	Sandstones coarse-grained red-coloured (dark) and more fine-grained, clayey schists with relicks of vegetation; diabases; dark bluish-grey sandstones coarse-grained and fine-grained with relicks of vegetation; volcanic ash.	To the North from the Saihan.
	Sandstones and blue schistous clays with relicks of vegetation; marine fossils	To the North from Daoba and the Kara-Kotal pass.
Upper Triassic and Ret.	Light sandstones and clayey schists with coaly beds	To the North from the Saihan (Kotali-Sabzak, Shisha-Valanh-Chakhil)
Upper Triassic	Thick-bedded marine sandstones, limestones and clayey schists with coaly beds	Chakhil, northern slope of the Kotali pass.
Middle Triassic	Brown sandstones and clayey schists with coaly beds	Sabzak
Lower Triassic	Marine sandstones and limestones with Halobia lomelly, Monotis Salinaria	

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I	2	3
Permocarboniferous	Alterated clayey schists(micaceous) with inclusions of graphite and antracite. Clayey schists with clayey matter are cut by amphibole granite.	The mouth of Saihan and northern regions.
Carboniferous	Large-pebble conglomerate,metamorphosed by granites;massive dark limestones with Brachipodes.	To the South from the Saihan.

By K.L.Grisbakh an active contact of trapps with the limestones of the Cretaceous time has been ascertatined(to the South from Saihan,beyond the investigated by us territory).

The intrusions of the amphobole granites are cutting the Permocarboniferous deposits and could be related,according to his opinion,to the Late Cretaceous epoch (the Upper-Triassic-Lower-Jurassic age is ascertained by us)/

The section of the terrigeneous coal-bearing deposits in the regio of Chakhilya-Shisha-Valanh K.L.Grisbakh considers as a Lower part of the Upper Triassic,superimposing the found relicks of vegitations with the Triassic forms of the Alps. The thickness of these deposits exceeds I200 meters;at their foundations the fossils,determined as Monotis solinaria,Halobia lomelly had been found. Our investigations have confirmed the presence of the Triassic deposits in these regions. However,in the Chakhil (for instance near the settlement of Sary-Assiya) they are divided by a dislocation with a break of continuaty from the larger upper part of the section,and the latter on the grounds of paleophitological data is related to the Middle Jurassic. Eaqually to the Jurassic and not to the Triassic age related the deposits developed at the pass of Kotali-Sabzak. K.L.Grisbakh is correctly superimposes the outcrops of the described deposits in the Chakhila and Shisha-Valanh,relating therefor the latter to the Triassic.age.

Without any foundations he subdivides the terrigeneous Pre-Cretaceous deposits at the up-streams of the Doab river(the region of the Aokhorack -Bala settlement),related now to the Triassic,now to the Jurassic ages. By error to the Upper Jurassis related the series of " Red Grit", which has a Lower Cretaceous age.

There are Cretaceous deposits fixed,which are not subdivideddby him in detailes. In the region of the Madr village the fresh-water deposits of the Pliocene,estuary and marine deposits of the Miocene and marine deposits of the Eocene are singled out. The latter are supposed on the grounds of the discontinuty of the section with the Cretaceous deposits

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at the basement and with the Miocene ones -at the roof. It is,however, ascertained by us that the Miocene deposits with a break of continuty and with unconsiderable unconformity lay on the Eocene deposits,that is the Oligocene deposits are excluded in the section.

A considerable role of the aeral processes in the process of loess and loes-like deposits accumulation as well as the unity of the processes,lead to the accumulation of the deposits during the Pliocene time, during Quaternary time and continuing at the present time,all these fact are correctly noticed by K.L.Grisbakh. The presence of glacier formation in the Shisha-Valanh,Chakhila and at another placess, is marked

The main paleogegraphical conclusions by K.L.Grisbakh are the following:

From the end of the Carboniferous time up to the Upper Jurassic one coast sediments are the predominant. Regression of a sea is continued during the Jurassic and Cretaceous time. Then a transgression begins, which reaches it's maximum during the Upper Cretaceous epoch and involving vast territories of Afghanistan.

After prolonged interval aproximately the same region was visited by G.G.Gaiden(I9II),who investigated the valleys of the Horband,Bamian, Saihan,and Kamarda from the settlement of Barfak in the East up to the up-stream of the Saihan river in the West,as well as other regions. To his report a schematical geological map of I:2 000 000 (approximately) scale is supplied.

G.G.Gaiden remarks the presence of anticlines between the Saihan and the Kara-Kotal pass,dividing at the extent of 20 miles three laying or overturned to the South anticlinals:the Saihan,the Dashti-Safed and the Bagjgakh. Their lower wings are complicated by gentle over-thrusts. The strike of the folds is north-eastern in the eastern part and latitudinal in the western one.

There the suppositions on the connection and the boundaries of separate mountain ridges is stated,in particular it is supposed to preserve the denomination of "Hindukush" beyond the main ridge,lolongated to the West up to 68° of the Eastern langtitude.

For the investigated territory G.G.Gaiden offers the following stratigraphical scheme.

Upper Quaternary deposits (the Sivalick series)

——————— unconformity ———————

Middle Quaternary deposits(?) in Horband

——————— unconformity ———————

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Lower Tertiary deposits(Eocene?)- Saihan and Kamard
Cretaceous limestones and schists
Series of"redcoloured coarse-grained sandstones"
The Saihan series

_____ unconformity _____

Volcanogeneous series of Daob

_____ unconformity _____

Hingil series of the eastern Afghanistan — Fusuline limestones of the northern Afghanistan

Helmend series
Limestomes of Khadjigek and hematite
Kalu series
Metamorphic and crystalline rocks of Kabul and Siakh-Kukha

Some series are indexed by G.G.Gaiden in the following manner: The most old formations of the Hindukush is considered to be the series of Kalu,related apparently to the Lower part of the Paleozoic age. It is composed by gneisses,micaceous schists and quartzites with thick benches of conglomerates. In the more yong Paleozoic deposits the series of Khadjigek is singled out,represented by grey and dark limestones,laying on the bed of hematite. The limestones are containing fossils of the Upper Devonian age , and at their upper parts-the fossils of Lower Carboniferous age. The Helmend series is composed by crystalline schists,fillits, quartzites,rarely by limestones and conditionally related to the Lower or Middle Carboniferous age. The series of"the fusuline limestones" of the Upper Carboniferous-Permian age is represented by grey massive limestones with separate interbeds of schists and quartzites; transgressively laying on more ancient deposits.

At the up-streams of the Saihan river near the settlement of Doabi-Mekhzarin by G.G.Gaiden the volcanogeneous series of Doab is singled out,unconformly overlapping the fusuline limestones and underlining the coal-bearing deposits. It's age is partly considered as Jurassic and partly as Triassic.

The coal-bearing series of Saihan (which is also for the first time was singled out by G.G.Gaiden) is related to the Jurassic age. Criticall considerating the notions of K.L.Grisbakh on the Triassic age of the coa bearing strata G.G.Gaiden came to the conclusion,confirmed by us also, that the most part of the Chakhil section is related to the Jurassic age In contrast to the idea of K.L.Grisbakh,G.G.Gaiden consideres the Saihan

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as a constituent part of the Anhar, but not of the Hondwana seri province.

Red coloured coarse-grained sandstones are related by G.G.Gaiden to the Cretaceous age and considered to be more yong than Barremian. The occurence with clear unconformity of the Cretaceous limestones, corresponding to the Senoman transgression, is marked here. However there is nothing mentioned about more clearly pronounced maastrikht transgression.

Confirming the data of K.L.Grisbakh on the gradual change of the Cretaceous formations by more yong, GG.Gaiden is mentioning about the conditionallity of the determination of the Cretaceous roof (by lithological features). He marks the unascertained by K.L.Grisbakh unconformity among the tertiary deposits of the Madra-Kamarda, relating the deposits above the unconformity (as it was supposed) to the Pliocene and below-only to the Eocene age.

In the description part of the areas (for example at the up-stream of the Saihan, Kamard, Doaby-Mekhzarin, Ishpushta, Dashti-Safed, Madar, Adzhar and Badzhgakh) an important role of disjunctive displacements is marked. Near the pass of Kara-Kotai G.G.Gaiden marks a large outcrops of "dark-green diabase", apparently representing by itself an intrusion among the Cretaceous rocks. As it is ascretained by us these formations are related to the Triassic age and occur among the Cretaceous deposits for the complicated tectonics of the region (abundunce of over-thrusts).

In the history of the geological development of Afghanistan G.G.Gaiden singles out four stages of folding. The first one is marked by an unconformity between the crystalline series of Kabul and Khingil(Pre-Carboniferous folding), the second interval of the sedimentation falls to the end of the Sillurian or beginning of the Devonian age, the third one apparently to the Lower Triassic, the fourth-after the accumulation of the series of redcoloured Lower-Cretaceous sandstones. Then the transgression is taking place, and at last, regression at the end of the Tertiary period.

Thus, G.G.Gaiden marks in general a correct scheme of the stratigraphy, corresponding to the observed by us also correlations. It is natural, that the complied more than half of centuary ago scheme was several times changed by the more late works.

Further constructions by R.Furone(I926, I94I) in many detailes had repeated this scheme. To the more ancient formations of the Hindukush, Kabulistane and the ridge of Baba R.Furon related "the metamorphic series" represented by ortho-and paragneisses, micaceous schists (often with garnet and andalusite), quartzites and marbles. The metamorphic

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rocks of the Kabul and the Kalu series (different by age according to G.G.Gaiden) he united intoone series,considering it to be a Pre-Cambrian and at it's upper part,apparently as Lower-Middle-Paleozoic one.

To the Devonian age the laying on the metamorphic rocks limestones with angular unconformity were related by him. The red-coloured limestones and the replacing them along the strike the aspide,roofing and micaceous schists,occuring on the bed of hematite,were conditionally related to the Lower-Middle Devonian age (later R.Furon related them to the Upper Devonian age). Only the above laying limestones with fossils were related to the Upper Devonian age,

The deposits of Carboniferous and Permian age are singled out as " the antrakolite series". R.Furon distinguished in it the concordantly laying on the Devonian deposits the deposits of the Lower and Middle Carboniferous,that is of the Dinant and Marine divisions (the Helmend series of G.G.Gaiden) and discordantly overlapping them the deposits of the Upper Carboniferous-Permian age."the Uralo-Permian" (the fusuline limestones of G.G.Gaidem).

Having studied the section of the volcanogeneous Doab series R.Furon had come to the conclusion that it's age is the Triassic-and Ret;the volcanic activity had finished in Ret,replaced by the accumulation of terrigeneous coal-bearing strata.

In the valley of the Kamarda R.Furon had ascertained the Paleogenes deposits (without dividing them in detailes),which had replaced the Cretaceous limestones and which are overlapped by the Neogene deposits with unconformity. In it's turn among the deposit of Neogene there is also an unconformity marked.

Considering the history of the country development R.Furon thinks that during the Devonian age the Caledonian folding had transphormed the region of the Hindukush into the area of land. During the Devonian time a small transgression had come,widely distributed after the first tectonic movements of the Hercinian epoch and during the Ural time. The furthe tectonic movements at the end of the Permian age lead to the uplifting of mountain chain,outlined by a number of volcanes,acting up to the Ret time. The North of the country (for instance the region of Chakhil) was involved by the local marine transgression during the Upper Triassic time The Jurassic period-is the time of quiet accumulation of terrigeneous strata. During the Neokome time an uplifting is forming and draining of the territory is taking place. The processes of denudation are appearing and river deposits are accumulating. For some period of time the country is involved by the Alb sea,then continental condition are again the pre-

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dominant as well as small transgressions and regressions of a sea with accumulations of lagoon deposits. During the Cenoman time a new transgression begins,which reaches it's maximum in the North during the Turon time and in the South -during the Cretaceous period. It apparently did not involve only the Alpine areas of the investigated by us region,located to the South from it. During the Upper Cretaceous epoch the depth of a sea is gradually decreasing. At the end of Cretaceous beginning of Paleogene time the emplacement of granitoides is taking place. The Paleogene sea is existing within the same limits as during the Upper Cretaceous but it gradually reducing,retreating to the North.During the Pre-Puntiches time important tectonic movements took place,leading to the uplifting of the Hindukush. Then the period of erosion comes and the period of alluvial accumulation. The sea is finally leaves the limits of Afghanistan. The Post-Puntiches movements lead to a new uplifting of a mountain country. A recent river net is forming;in depressions the coarse-grained deposits are accumulating.

The work of R.Furon(I926) is accompanied by summary geological map of I:IO 000 000 scale. This map is of not great interest,as on it approximate boundaries of the distribution of only crystalline,Paleozoic,Mezozoic and Cenozoic formations are shown. On the schematical geological map of the Hindukush and the Kabulistan of I:I 000 000 scale the Tertiary and Quaternary deposits are singled out as well as Cretaceous,Jurassic,Anktakolite and Devonian crystalline and igneous rocks. The latter in particular are accupaying in reality more small areas,then it is show on the map.

Later R.Furon (I934) again returns to some the most general questions on the geology of the country. He considers in particular that the Hindukush and the Pamirs are forming a single structural unit. Again it is mentioned about the manifestation of Post Jurassic and about two phases of tectonic movements of the Alpian period: at the end of Paleogene and during Neogene time.

Speaking about the structure of the territory R.Furon considers that the Hindukush as a main is representing by itself a granite dome, the sedimentary mantle of which is eroded. To the North from it a series of rectilinear and lolongated folds with latitudinal orientation is singled out. They are the anticlinals of Bamian and Akrabat (to the South from out territory),synclinal of Saihan,anticlinal of Dandan-Shikan, synclinal Surkhab,anticlinal Kamard (recumbent fold,overturned to the South), anticlinals Kara-Kotal and Umakai. Nearly all the folds are overturned to the South;in the very direction the displacement of masses

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along the complicating wings of the folds gentle overthrusts, plunging to the North.

R. Furon adduces the first geological data on not investigated before regions: the down-streams of the Surkhab river, by the valleys of Andarab and Pandzhsher. The ending of the Triassic volcanism in Ret was ascertained by him, as well as the presence of unconformities in Neogene, the first study of some rocks under a microscope carried out by him.

In 1932 the Hidukush was crossed by K.Brukl on his way to the Badakhshan(1935). In his observations he also followed the scheme of the G.G.Gaiden stratigraphy. The investigated territory is located to the East and North-East from that of studied by us, overlapping only in the region of settlements of Nakhrin and Kishakton. K.Brukl adduces the description of different Jurassic rocks on the way from the region of Farkh ar river up to the salty dome of the Namakab. Another salty deposit is marked by K.Brukl in the region of Chal settlement, mentioning about it's Tertiary age. The Kimmeridge-Titonian age of the salt is ascertained by us.

On the investigated territory K.Brukl singles out the following sub-divisions:

Quaternary system	Pleistocene
Tertiary system	Sivalik series
	Pliocene
_____ unconformity _____	Miocene
_____ unconformity _____	Eocene
Upper Cretaceous	Senon
Middle Cretaceous	Senoman
_____ Unconformity _____	
Lower Cretaceous	" The red grit" series(Neokom)
Middle Jurassic	Saihan series
Partly Triassic & Partly Jurassic	Doab series
_____ unconformity _____	
Upper Permian-Upper Carboniferous	Fusuline limestones.
Middle Carboniferous	Helmend series
Lower Carboniferous	Khadjigek series
Upper Devonian	
Lower Paleozoic	Kalu series

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In I942 V.D.West had investigated coaly deposits (I942). As a result of his works some interesting information both on geology of several regions and on some deposits was received. For instance, a great unconformity between the series of Doab and Saihan was confirmed by him; a pinching out of the lower part of the Saihan series with the main coaly horizon in the direction to the East from the Ishpushta was ascertained;the dislocations of the deposits was discovered. At the coaly deposit of Ishpushta 6 coaly lenses had been studied. With the help of adits it was ascertained that all the coaly seams are characterized by frequent pinches and swells up to a complete thinning out;the maximal thickness is I3-I4 feet. The calculation of the minimal reserves by all the 6 lenses amounts 2I6200 tons.

According to the conclusion of V.D.West the most interesting is the coal from the lense No.I (slightly coking).

In the process of the further works it was ascertained that the developed to the East from the settlement of Barfak Saihan deposits reach the thickness in this region of I400 feet and are represented by the upper part of the series(in contrast to the Ishpushta where the thickness of more full section exceeds 4000 feet). In the report there is an information given on the structure of separate areas. There the tectonic contacts as well as the overthrusts of the Doab series on the Saihan one are marked; steep folds in the Saihan deposits are also marked here.

To the North from the settlement of Barfak and Tala V.D.West marks the bluffs in hard Cretaceous limestones,located at the left slope of the Surkhab river valley;the limestones are laying on the series of Saihan and Red Grit in contrast to the hilly relief,developed on the Doab deposits by the right slope of the valley. In a bluff near the settlement of Barfak-Surkh-Komar the overthrust of the Saihan deposits on the Cretaceous ones is marked. To the West from the settlement of Tala 3 steep folds in the Cretaceous limestones are ascertained;there is even the overthrust of the Cretaceous limestones on the Quaternary conglomerates marked.

The geological map of I:25 000 scale compiled by V.D.West involves a strip of the Saihan deposits development,with their roof and foot,lolongated in the direction of North-East,the width being 6-8 meters and with the length of more than 30 km. This map is very schematical one. For example,on the list of Ishpushta 4 stratigraphical sub-divisions are singled out: Cretaceous limestones,Red Grit series,the series of Saihan and the series of Doab. Besides it, the coaly lenses and dikes among the Doab formations are shown. Absolute absence of dislocations with a

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break of continuty is very surprising.

The rest sections of the V.D.West report had been written by his assistant Mr.Fakhruddin Akhmad. Describing the valley of Saihan he notes that among the Permian limestones,unconformably laying on the quartzites of the Helmend series dikes of gabbro are found. Strongly pronounced dislocation of the deposits by the left (northern) slope of the valley is marked:numerous fractures,overturned folds,in contrast to the monoclinal occurence of the Helmend series,as well as the Cretaceous and Tertiary deposits by the right slope of the valley. The conclusion of G.G. Gaiden about an absence of industrial coals in the valley is confirmed: the most thick seam here reaches I,5 feet,containing interbeds of schist and is traced at the distance of more tham I00 feet.

Describing the valley of Chakhil,by the slopes of which the Saihan deposits are outcropping with sharp unconformity overlapped by Cretaceous deposits F.Akhmad indicates to a single perspective area for coal. It is an area located to the North from the settlement of Sary-Assiaya ; this fact is also confirmed by us(see Kudryashov N.S.,and others,I966).

According to the recommendations of Mr.Mr. Rakhimulla-khan,Said Abdul-khan and A.Drat, Mr. F.Akhmad had visited the region of the settelment Rui. Observing during I940 year the outskirts of the RUi,the mentioned above persons had supposed that at the distance of 6-7 miles to the North-West from the settlement of Rui the hills could had been composed by rocks of the Saihan series. Mr. F.Akhmad ascertained that in the core of an assimetrical fold among the Cretaceous rocks a gravel was outcropping as well as dark conglomerates and phillites with quartzy veinlets,supposedly more old than the series of Saihan. By us again in the very fold besides the rocks mentioned above (Triassic andCarboniferous) diorites,on which with a erosion by water lays Maastrikht,had been discovered. The Saihan deposits are absent here.

The area of Darra-i-Suf Mr. F. Akhmad considers it to be characteristic for wide development of the Saihan deposits,most part of which are hidden under the Cretaceous and Tertiary mantle. In I942 a geological survey had been carried out here and a map on two sheets had been compiled with a sclae of I:25 000. On this map an erosional window with an area of nearly 50 sq.miles with the outcrops of the Saihan series from the Darra-i-Tor and the Sadnardi up to the Shabashek isshown,as well as a small window (nearly 3 sq,miles) at the up-streams of the Sary-Tor valley. In contrast to the Ishpushta,where according to the viewpoint of Mr. F.Akhmad a concordant occurence of the Cretaceous limestones of the Red Grit series and the series of Saihan (what is erroneous according to our data) is marked,in the Darra-i-Suf the Cretaceous

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limestones with unconformity lay on the underlaying rocks. Especially well this unconformity observed in the North-Western part of the Chikh-il-Dukhtarana (to the West from Shabashek), where the Saihan deposits are dipping to the South-West under the angles of 25°, and the Cretaceous limestones (the Senoman-Touronian ones as it was ascertained by us) are gently plunging to the North. As another evidence of this unconformity Mr. F.Akhmad considers substantial and quick ranges of the Red Grit series deposits thickness, which was continuing the sedimentation of the Jurrasic period, according to his opinion.

For the region of the Darra-i-Tor-Shabashek by F.Akhmad it was ascertained the presence of two folds: an anticlinal one the Darra-i-Tor (from the Dakhani-Tor up to Kotali-Marak) and a synclinal one-Skabashek (to the South from the mountain of Kukhi-Hamark) lolongating via the Shisha-Valanh in the East, to the South from the Shabashek settelment). A number of more small folds are ascertained by us as well as fractures which are not mentioned by F. Akhmad.

Valuating the thickness of the Saihan deposits (the base of the series is not stripped) F.Akhmad considers that in the region of Shabashek-Reg-Bulaka it exceeeds 5000 meters. However, by our works it has been ascertained that the thickness of the Saihan deposits amounts I370m

Considering the questions of coal-bearing F.Akhmad marks several steep coaly seams at the Shabashek and at the Darra-i-Tor - two of them which are gently laying. For all this, the coaly seams of the Shabashek are related apparently to the more upper and the beds of the Darra-i-Tor - to the more lower horizons of the Saihan series. The outcrops of the two seams of coal are plotted on the topographical map of the I: 2000 scale and are traced for 2500 yards. The descriptionsof all the main seams of coal determined at the Darra-i-Tor are given. They are the 6 feet thick seam-the main one; the seams to the North-West from the settelment of Marak, below the mark of 844I feet; 6 feet thick bed between the settlements of Marak and the mark of 7693 feet; the seam at the Sary-Tor; 6 feet seam at the western part of the Darra-i-Sufa. The recommendations on the exploitation of coaly deposits of the Darra-i-Sufa are given.

Minimal reserves amount 5 585 000 tons, and together with the Shabashek - I4 500 000 tons. The coal is of best quality than it is at the Ishpushta. Short information on another coaly manifestations in this region is also given. It is a sai of Jari-Sokhta (to the North-East from the coaly seam of the Darra-i-Tor) with lolongating for 325 yards coaly seam, being in thickness 3-3,5 feet and with the reserves of I0000

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tons of coal. The second area is located at the outskirts of villages of Darvaza,where several seams of coal are known (of low quality),with the thickness up to II feet.

In conclusion F.Akmad stresses that out of the three investigated coal-bearing areas (the Ishpushta,Darra-i-Suf,Chaknil-AoKhorak) the latter is of not great importance.

At the Saihan, Kamard and Balkhabe coal is not met,but even when it has been found the output of it would be connected with great difficulties(transport ones and so on).

In the report of V.D.West(I942) detailed information on the structure and the character of the coaly seams of the Shabashek deposit,discovered by Hulyam-Ali khan and then observed by A. Drat are given. The main syncline,composed by coal-bearing deposits of the Shabashek height is opening to the East-South-East. Fróm the South a conjudated with it anticline is located. On the map of I:2000 scale 9 the most significant seams of coal are singled out with the thickness of from 3 feet and more from the first-upper up to IX th lower ones.

Total minimal reserves of coal by all the nine seams are valuated by V.D.West as to be 9028244 tons.

In the fonds of the Department of Geology and Mines numerous analogical reports are preserved,devoted to different problems of exploitation of coaly deposits,on the profitableness of exploitation,on a quality of coals and sometimes these reports are contaning only short and fragmentary information on the geological structure of these areas(Drath, I939),I940,I94I;Jhulam Mohamad,I946,Hinre,C I962,Mc.Juire H.R.,I947, Sanford R.S.,I950,Siebdrat H.,I96I; Walsh M.A.,I950 and many others).

In I940 the work by B.A.Petrushevski has come out. The questions on the geology of Afghanistan are elucidated here according to the published in literature works,which are often not complete and sometimes are contradictory. Nevertheless the author has succeded to compile a very interesting summary on the geology of the country,which is of great importance even at the present time.

B.A.Petrushevskii(I940) is enumerating all the known up to that time stratigraphical sub-divisions on the territory of Afghanistan. Among the intrusive formations he is mentioning the Lower Paleozoic,Paleoxoic and Pre Upper Cretaceous. Indicating to the unclearness of the question on the Caledonian tectogenesis B.A.Petrushevskii marks the role of the Variscian movements(which had begun after the Lower Carboniferous and manifested between the Middle and Upper Carboniferous time),which had involved as in the main the North of the country. Further tectonic movements

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are taking place at the end of the Upper Permian time - Triassic time, without accompanying by intrusive activity. They involved vast areas and lead to the formation of stable structures. During the Middle Triassic time new sharp movements took place (Paleocimmerian ones) with unusually intence intrusive activity. As a result of the Paleocimmerian movements a regression of a sea and not considerable uplifting of the territory are taking place. But as far back as in the Upper Triassic time the western Hindukush and the Paropamiz are covered by sea. During the Lower-Middle Jurassic epochs an accumulation of thick continental deposits is taking place. More considerable movements took place during the Upper Jurassic time. As their reflection serves the fact of the Upper Jurassic deposits absence as well as the continental character of the Lower Cretaceous ones. During the Upper Cretaceous epoch and Paleogene the Hindukush is uplifted. The rest of the territory during this time is the area of sinking. During the Neogene and Quaternary time the Alpine movements are taking place. However angular unconformities between Neogene and Paleogene are marked in the northern Afghanistan only, they are absent in the South. Dislocation of the Afghan Turkestan during the Mezozoic and Cenozoic epochs had a subordinated character: gentle folds are formed with extened monoclines. They are complicated by thrusts, ovrthrusts, overturning of the Cretaceous deposits being lovated near the Paleozoic cores. In the North the folds are completely composed by the Cretaceous deposits, to the South - in the cores of them the Jurassic, Triassic and igneous rocks and then the Paleozoic ones are met. At the Hindukush the inclination of the folds to the South could be observed.

B.A. Petrushevskii is correctly suggests (considering the investigated by us region) that one can not speak about the Alpian folding as being eaqual to the Variscian or Cimmerian ones. This folding has not a geosyncline character. That is why the Alpian movements he considers as a transition (intermediate between platform and geosyncline ones) folding. Respectively the investigated by us region falls in its South-Eastern part in the area of structures of "Paleocimmerian geosyncline folding" (as the whole Hindukush), and in the North-Western one - in the structures of " Yongcimmerian geosyncline folding". The data received by us lead to somewhat different conclusions.

In I950-52 years S.A.Popol and S.V.Tromp began the studying of the sections of different deposits sedimented along the Transafghan circle highway(I954). Within the limits of our area the sections by the Surkhab river from the settlement of Doabi-Mekhzarin up to the mountains of town of Pul-I-Khumrm near the salty deposit of the Namakamb had been studied by them.

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The authors considered the age of metamorphic rocks of Afghanistan as to be not older than Devonian, connecting their metamorphism with the emplacement of the lolongated intrusions during the Early Jurassic, Oligocene and apparently during Post Paleozoic time. (In particular, the crystalline schists near Kabul city they related to the Late Paleozoic and even to the Mesozoic time, without taking into consideration the data of G.G.Gaiden on the unconcordant occurence of the limestones of the Upper Carboniferous-Permian age on these metamorphic rocks). Above by the section the mentioned authors single out the Upper Devonian deposits which are dividing (from bottom to top) as follows: thick green coarse-grained pebbled conglomerates; seam of hematite; schists and dark limestones with fossils of the Upper Devonian and Lower Carboniferous age. This stratum (as judged by the scheme of the deposits correlation) they call as Kalu series(?!), ignoring the supposition on it expressed by G.G.Gaidem. According to such an idea the series of Kalu is overlapping the series of Helmend, which was related by S.A.Popol and by S.V.Tromp (without any explanation of the reasons of the G.G.Gaiden's ideas revision) to the Lower Devonian. Further above the dark grey limestones with brachiopoda, bryozoan and fusulinids of the Lower Carboniferous age are singled out. It is noted that they are overlapping the metamorphic series of Helmend (there is nothing said about the character of the contact). Above by the section lay limestones of the Upper Carboniferous age with interbeds of quartzites and schists, laying either on the Lower Carboniferous or on the metamorphic schists. The limestones of the Lower and Upper Permian age are forming a continuous section with the limestones of the Carboniferous and the Lower Triassic age and are contaning fusulinids and foraminifers.

The Triassic deposits (singled out by the mentioned above authors into the "Lower series of Doab") have a complicated structure for an unconformity at the roof of limestones of the Lower Triassic age as well as at the basement of the volcanogeneous series of the Lower Jurassic age. The latter is singled out by S.A.Popol and by S.V.Tromp denominated as "Upper series of Doab[x)]. Large granite batholiths in the regions of Doabi-Mekhzarin and Ishpushta are related to the Lower Jurassic time; it has been supposed that they compose a united magmatic complex with the formations of the Upper series of Doab and are deliberately Pre-Cretaceous, as the pebble of these granites is composed by conglomerates of the Grit series, appearing in 70 m. above the foundation of the series.

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x) In the reference book (Menesie G., 1963) it is erroneously poited out that the "Upper series of Doab" is related by Tromp to Ret-Upper

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Above with clear angular unconformity(for example near the Ishpushta) occur the Middle-Upper Jurassic formations subdivided by S.A.Popol and S.V.Tromp into Lower,Middle and Upper series of Saihan,the total thickness of them being near to 580(?) meters. Concordantly,but sharply the Jurassic green-grey deposits are transiting into redcoloured ones laying above. But in some places along this boundary one can observe a small discontinuty in sedimentation. For the Upper Cretaceous deposits by the mentioned above authors a quick facial variability of the deposits is marked. Among them the Senoman,Turon(by mistake an unconformity betweem them is stated) and Senon are singled out. From the field of vision for some reason the Dat stage aswell as the Paleocene,everywhere developed in Afghanistan are falling out. The authors by mistake point out for the absence of Eocene stage. To the Oligocene they relate an intensive volcanic activity and the emplacement of intrusions,proceeding from the correlations in the North-West and in the South of the country. Erroneously by them the salt-bearing Miocene in the region of the salty deposit of the Namakab(Takcha Khana) is singled out(by us the Kimmerij-Titonian age of the salt is ascertained)/ Above by the section by S.A.Popol and S.V.Tromp the Pliocene,Pleistocene and Quaternary deposits are singled out.

Stating in short the main features of the development history and of the tectonics of the country the authors indicate to an important role of the vertical(oscillating)movements,which were practically not accompanying by folding. The first intense folding according to their point of view only was at the end of the Pliocene time. It is impossible to agree with this statement: on the only one studied by us area numerous epochs of breaks,tectonic movements and of folding are ascertained. In the work of S.A.Popol and S.V.Tromp there is a great number of various alterations and additions in the contrast to the existed before notions of the geological structure of Afghanistan. However,the geological observations had been carried out during an extreamely short period of time and on a large area,by this fact apparently it is explained that a number of these observations are errenous ones.

In I953-55 years A.Dezio(I960) had visited Afghanistan. He describes in short the structure of the covered by routes regions of the country, for instance from the beginning of the Shikarii ravine via the Hindukush and Pul-i-Khumri up to the Kunduz.

The deposits' description A.Dezio is making proceeding from the stratigraphical scheme by G.G.Gaiden with alterations and additions of S.A. Popol and S.V.Tromp. He markes that in Afghanistan there are metamorphic

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as well as the usual facies of the same by age formations, the correlation of which was not managed either by K.L.Grisbakh or by G.G.Gaiden. The age of the metamorphic rocks, laying under the most ancient ones (out from the faunistically characterized deposits of the Upper Devonian age) is considered by A.Dezio to be Devonian. His indication on the presence of grey limestones with foraminifera of the Middle and Upper Carboniferous age "near the Doshi" is of interest. These outcrops, however, have not been discovered by us (true, the boundary of the studied by us territory runs directly to the South from the Doshi). The Cretaceous deposits of the Pul-i-Khumry are sub-divided by A.Dezio into the series of Red Grit (beginning of the Cretaceous time up to the Senoman one), series of Senoman, Turon and Senon. There are prelimenary suppositions on magmatism stated here. C haracterizing the tectonics of the region A.Dezio speaks about the "united zone of Hindukush" located to the North from the zone of fractures-"line of Horband"

On the grounds of the episodic field works carried out by Z.Makadza (I960) he published a summary on the main commercial minerals of the country. In the process of the works a geological map of the country in I:2000 000 scale had been compiled. On this map 4 petrographical subdivisions (effusive and intrusive rocks) and IO stratigraphical (from the Pre Cambrian up to the Recent Post glacier deposits) are singled out. But the map, however, is very schematical one and provides approximate (far from being correct sometimes) notion on the structure of some regions.

In I960 the first, as a matter of fact, summary work on the geology of the whole Afghanistan - " Stratigraphical reference book" by G.Mennesie (I960) had came out. This reference book contains a list of denominations as well as short discriptions of different stratigraphical sub-divisions, singled out in the country during all the years of its investigation. In this reference book the sub-divisions which stratatypes are located within the limits of the investigated by us territory (the series of Doab, Saihan, etc.) also described here. But in a number of cases G.Mennesie gives alterations for the sub-divisions of different authors, without their reservation.

In connection with the beginning of search-exploration works for oil in I957 in the northern Afghanistan the geological-surveying works are being carried out. By the survey of I:500 000 scale the region up to the border with the USSR to the North from the studied territory is involeved, involving its North-Eastern part, between the villages of Ishkamysh-Kishkton also (Bratash V.I. and others, I96I). From the South to this territory the region of Pul-i-Khumry is adjacent, survyed in a scale

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of I:253440 (Makhnev A.M. and others,I962). Within the limits of the involved by these maps territory a small area in the region of the Khanabad town is located,for which a map in I:50 000 scale is compiled (Ivanov S.D. and others,I963,I964). In the process of the maps compiling the main phenomena on the stratigraphy and tectonics of the territory with a quite enough completeness (taking into consideration the scale of the maps) had been ascertained and reflected on the geological maps.

In the process of our works the general idea on the structure of mutually overlapping areas are not changed. By us the Paleozoic and Mesozoic formations are more detailedly sub-divided as well as some additional detailes on the tectonics are ascertained. Completely by us the scheme of the Tertiary formations' separation,elaborated in the process of the mentioned works' carried out,is adopted. Among the Tertiary formations the following series are singled out: the Shafii series of Oligocene and Miocene,the Koshtangin series of Miocene and the Rustak series of Pliocene. All these sub-divisions are singled out by us also.

Within the limits of the works for oil the study of the Mesozoic deposits sections at a number of places is carried out (Khatiskatsi G.N. and others,I963) including on the our territory near the villages of Dakhani-Tor,Madr,Doabi-Mekhzarin,Ishpushta,Doshi(Kampirak),Pul-i-Khumry,Chal Farkhar-Hazistan.

All the sections are in detailes studied and fractionally separate on the grounds of abundant collection of fossils and vegetation remains; these sections were used by us as reference ones. Our investigations confirm the conclusion of G.N.Khatiskatsi on the important role of the Pre-Maastrikht washing out as well as on a considerable Maastikht transgression. Some alterations and corrections are made only for the section of the Triasic and Jurassic age,observed by us in their aeral distribution,as well as for the seris of Red Grit".

At last,on the grounds of the mentioned and others works the geological map of the Northern Afghanistan in a scale of I:500 000 was compiled (Bratash V,I. and others,I964),later transphormed into the map of I:I000 000 scale,as well as Structural map of the northern Afghanistan in a scale of I:500 000 (Roschin V.F.,I964). On this map some structures and fractures are singled out. Within the limits of our territory—the "zones of forefolds" of the Hindukush in the South-East and"epiplatform orogenical zome" in the North-West.

In I96I the geological investigations in the valley of the Kamard river were carried out by A.Lapperant (I963). Among the developed here deposits 5 stratam of the Jurassic and Cretaceous age are singled out by him. With an angular unconformity on the weathering crust of the Triassi

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age the series of Saihan is laying,contaning the lenses of coal in the Ishpushta. They are apparently divided by a phase of folding. Above by the section lay redcoloured fragmental formations of a continental origin -the series of "Red Grit",laying as if concordantly(though to the North it is overlapping the more old deposits) on the Saihan formations. The Lower stage of sedimentation begins with the accumulation of red limestones,sandstones and conglomerates,corresponding the transgression of the Maastrikht sea. Above by the section they are replaced by clayey and sandy limestones also contaning the Maastrikht fossils. The section is finished by the marbled stratum preserved in the cores of synclines and contaning the interbeds of gypsum. The latter (replaced to the top by conglomerates) testifyes to the regression of a sea. In view of the fact that the fossils are absent here A. Lapparent conditionally relates it to the very Upper Cretaceous age.

In the process of field works by A. Lapperant a schematical geological map in a scale of I:50 000 of the Kamard river valley had been compiled,on which the enumerated sub-divisions are singled out. From the given description it is following that to the Maastrikht stage the author had related the developed here limestones of the Dat -Paleocene time also; the very Upper series as it is ascertained by us is related to the Suzak stage.

During this time A.Lapparent investigated the deposit of Khaji-Hek and ascertained the disconcordant occurence of the limestones of the Upper Devonian time on the quartzites and schists with the interbeds of ~~xi-~~ ~~xxxxxxx~~ hematite. The latter had been related by him to the series of Kalu,in contrast to G.G.Gaiden considering them to be the part of the Khadji-Hek series. The age of these deposits was considered as to be Pre-Cambrian(I962).

Later A.Lapparent and G.Mennesie (I962) had summarized the observations over the Pre-Cambrian deposits of Afghanistan,suggested for the Hindukush the following sequence:

At the basement-the Maidan series(gneisses,schists,quartzites,metamorphosed sandstones and marbles);above by the section-the Kalu series (sericite schists,underwent an epizonal metamorphism). Unconcordantly on the gneisses(Maidan series?) lays the series of Kotandar(slightly metamorphosed sandstones and schists) and it is transgressively overlapped by Carboniferous deposits. The age - Late Pre Cambrian-or Riphean. The series of Helmend of G.G.Gaiden was considered as to be of the same age as the Kalu series.

Later into the Paleozoic division of the G.G.Gaiden scheme an esser

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tial correlations on the grounds of iron deposit of Khadji-Hek study (Kusov I.K.,Smirnov M.S. and others,I965) were introduced. It has been ascertained that into the series of Kalu of G.G.Gaiden two different by age stratum had been included,which are contacting by the fracture; respectively in this series two stratum - "Joakul"(supposedly of Proterozoic age) and volcanogeneous-sedimentary series,separeted into three series: Kab,Ouband and series of green schists are singled out. In the series of Ouband the Visei fossils are discovered.

Besides it in the region of the deposit the series of Khadji-Hek of the Upper Devonian-Lower Carboniferous time and the series of Kharzar laying on the former with stratigraphical unconformity,correlated with the Lower part of the Helmend series by G.G.Gaiden and conditionally related to the Lower Carboniferous are singled out. The two series are contacting with the obove described along the Khadji-Hek-Kharzar fracture,apparently abyssal one,traced along the whole southern slope of the Hindukush and which is dividing the sharply different structural-facial zones during the Paleozoic time at least, For instanse,the Lower Carboniferous to the North from this zone is composed by volcanogeneous-sedimentary formations,but to the South from it-by limestones concordantly replacing the Upper CDevonianrous deposit$s. As a result of a prolong existence of this zone of abyssal fracture the singled out by us (see below) Paleozoic formations could not be with any sufficient confidence correlated with far back ago ascertained as a main to the South from this zone and described above divisions of the Paleozoic time.

In I959-63 by the geological German mission in Afghanistan geological works on several areas located within the limits of studied by us territory had been carried out. In I962-63 years D.Veippert carried out geological survey in the region of Doab-Saihan-Adzhar (I964),having compiled the geological map of I:20 000 scale for the area of nearly 6000km^2. In its northern-eastern third part this area is overlapping the studied by us territory. Taking into consideration the short period of the works carried out by D.Veippert and wide use of aeral photo materials interpretation while compiling the map, it is natural that under all its advantages a number of questions of the geological structure of the region are stated by us on the grounds of the field observations somewhat differently.

The stratigraphical scheme of the studied region is represented by D.Veippert as follows below:

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Plio-Pleistocene	Coarse gravel of terraces and upland
Plio-Pleistocene	The Safed strata
Oligocene-Miocene	The Madar strata
Middle and Upper Eocene	The Karauna strata
Lower Eocene	The Hazak strata
Dat - Paleocene	The Badzhhak strata
Upper Cretaceous(Santon up to Maastrikht)	The Adzhar strata
Lower Cretaceous?	The "Red Grit" strata
Jurassic	The Saihan strata___ Volcanogeneous rocks and the Daoba plutons.
Triassic	The Doab strata
Permian?	Strata of fusuline limestones
Pre Permian formations	Phillites and micaceous schists

All the divisions (with the exeption of continuous sequence from the Adzhar strata up to the strata of Karauna) are divided by unconformities.

Phillites and sericite-chlorite-quartzy schists are the most ancient formations in this region and are related by us to the Lower Paleozoic, as they are overlapped by limestones of the Sillurian(?)-Devonian age. The latter contain the Devonian fossils and are overlapped by the depoθ sits with Visei fossils,that is why their relation to the fusuline limestones of the Permian age according to G.G.Gaiden is erroneous.

The Triassic deposits are lithologically(but without so detailed stratigraphical separation) divided by D.Veippert quite detailly. On the grounds of the supposition with the located int/ the North areas the volcanogeneous strata of the Middle and Upper Triassic,the terrigeneous stratum of the Karnii and Norii stages and volcanogeneous of Ret stage are singled out by us to the North from Doabi-Mekhzarina(Madrak,Ferrozak) The Jurassic deposits in the region of Saihan-Ishpushta are separated by as more detailed.

The Santon-Maastrikht age adopted by D.Veippert for the strata of Adzhar is of doubt. In this region as well as in the North among the analogical by the composition deposits on the grounds of paleontalogical data the Senoman-Turon and Maastrikht deposits are singled out by us. Both of them are corresponding to the stages of the Cretaceous sea transgression. The Konyak-Kampam stages are absent in the section. The Dat-Paleocene age of the strata Badzhakh does not arise any doubt. It should be

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noted however that in the northern regions the analogical formations had been singled out under the denomination of"Huri limestones" that is why the introduction of one more denomination for the alike by type formations and for the same stratigraphical volume is unnecessary.

The strata of the Hazak and Karauna,judged by their description,are corresponding to the singled out by us Suzak stage of Eocene. The collected by us microfauna is analogical to the faunistic complexes,developed in the same by age formations(Suzak ones) within the limits of the whole northern Afghanistan. The Middle and Upper Eocene(the Alai and Turkestan stages) are represented by another deposits,with their own complexes of fossils. That is why the separation of the Middle anfd Upper Eocene in the region of the Madar village by D.Veippert seams to be disputable.

Apparent misunderstanding is the separation of "volcanogeneous rocks of the Ferrozaka" as Oligocene-Miocene formations and supperimposition of them with the Turkestan formations in the North-West of the country (see Bratash V.I. and others,I964). In the indicated by D.Veippert places among these volcanogeneous rocks the Triassic fossils are discovered by us.

The rest of the sub-divisions are almoust without any remarks.

Within the investigated by him area D.Veippert singles out two main structural units: the Hindukush with the ascertained Pre Permian regional metamorphism and with Early Cimmerian tectonic movements as well as the foreland of the Hindukush,the Tertiary and Mesozoic mantle of which is crumpled into folds during the Oligocene time and underwent the action of fracture tectonics during the Oligocene-Miocene(?) time. Our idea on the tectonics and on the development history of the region is somewhat different(see the section "Tectonics").

During I960-6I years in the region of coaly deposits of Chak and Zamburak the geological survey was carried out by K.Khintse(I964). A geological map in I:50 000 scale and a schematical geological map for a vast area in I:250 000 scale were compiled by him.

On the first area some alterations are introduced by us. More detailly divided the "Pre Permian formations" of K.Khintse as well as terrigeneous stratum of the Jurassic age. It is ascertained that the separated by K.Khintse "lightgreen" tuffites are representing by themselves the hornfeled rocks of the Triassic age or of the Jurassic one and along the strike they transform into normal non-alterated rocks. By error K.Khintse considers the terrigeneous stratum as"Red Grit" (Callovian). The relation of the salt-bearing and gypsum-bearing formations(of the Kimmerij-Titon) age) as well as the relation of limestones to the Upper Cretaceous age (Callovian-Oxford) is also incorrect. At last,the singled out by him frag-

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mental deposits as Oligocene-Miocene are parallelized by us with the Koshtangin series, that is related to Miocene. The tectonics of the region is supposed to be much more complicated. The areal map by K.Khintse for the region of Nakhrin-Khanabad-Ishkamysh is very schematical one and provides an approximate idea on the developed on this territory deposits only, characterizing by the same mistakes in the identification of the strata as the detailed map is. A number of interesting idea are expressed by K.KHintse conserning the tectonics and development history of the region.

During I959-6I years G.Gabert carried out the geological survey in I:25000 scale in the region of coaly deposits of Karkar-Dudkash and to the South from it(I964). The Triassic and coal-bearing Jurassic deposits are quite detailed sub-divided by him(the correlation of the age of some sub-divisions is given by us). However it was erroneously related to the Lower Cretaceous age the carbonaceous-clayey stratum of the Kimmerij-Titon deposits (the age of the redcoloured stratum is specifyed by us as Neocom-Apt one). The deposits[illegible]tion of the very series of "Red Grit" (redcoloured fragmental rocks) lay on the Kimmerij-Titon ones with an evident washing out though without noticeble angular unconformity. The presence of the Alb stage is also ascertained by us which is absent in the scheme of G.Gibert. Being not separated by the latter author the Upper Cretaceous deposits are divided by us up to stages. The singled out by him fragmental deposits of Oligocene-Miocene(?) are related by us to the Rustak series of Pliocene.

Considering the history of the region's development G.Gibert is connecting the regional metamorphism of the most old deposits with the Variscian orogenesis. According to his viewpoint the next folding is taking place in Paleogene only,

After the organization of the Department of Geology and Mines at the Ministry of Mines and Industries in I963 year G.Gibert organized a number of geological investigations. One of them-the geological survey of the described in the present report region. Simultaneously with this in I963-64 the geological works had been carried out at the coaly depos: of Shabashek(Androsov B.N. and others,I965). As a result of these works the comprehensive valuation of the coaly deposit was carried out as wel as the suggestions on its exploitation given.

According to our recommendation (on the grounds of the field data of I963) the coal-exploration party had carried out the geological-expl ration works at the coaly deposit of Sary-Assiya(Chakhil). As a result of this work is the geological map of I:5000 scale as well as a comprehensive valuation of the deposit (Kudryashov N.S. and others,I966).

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Partly according to our recommendations within the limits of the studied area another two parties had carried out their works also. One of them had investigated the discovered by us celestine deposit of the Tank-i-Muruch (Kazak Ju.M. and others,I964),the second one- the investigation of the Shabashek,Sary-Assiya,Pul-i-Khumry,Ishpushta,Taly and Barfak regions for refractory and moulding clayes (Meshkovski A.E.,Dvornikov G.P.,I966).

Such are the main geological investigations,carried out up to the present time in the northern parts of Afghanistan which are to some extent conserning the region under investigation,described below. In the present section of the report in a number of cases it is mentioned only about the idea of this or that author without our estimation on the problems touched upon by them as a reader himself can find out it without any difficulties while reading this report.

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Chapter III
STRATIGRAPHY

The deposits composing the territory of our interest are very different for their age, composition and facies. There are deposits of probable Proterozoic known, singled out by us under the denomination of Fulul series. They come out to the day surface on the limited by area sections and we have little amount of data on them. The deposits of the Paleozoic group are represented by exclusively morine sedimentary and rarely by volcanogeneous facies. Among them the Early Paleozoic, Sillurian-Devonian, Carboniferous and Permian ones are singled out. The Mesozoic group is represented by both morine sedimentary and volcanogeneous facies as well as by continental ones. Among these deposits the Triassic, Jurassic and Cretaceous deposits are singled out. The Cenozoic group is represented by morine facies of Paleogene and by continental ones of Neogene and Quaternary systems.

The separation of all these deposits in dependence to their lithological composition as well as to the paleontalogical characteristic is carried out with different degree of detalization. A great number of sections of different stratigraphical subdivisions(fig 8) the description of which is given had been studied. The idea on the stratigraphy of some systems is not the same. The ancient series and the whole Paleozoic deposits are described for the first time. The deposits of the Middle Triassic were not studied before also. The Upper Triassic deposits in the central part of the territory under investigation had been described before in detail. The Jurassic deposits had been studied uneven: in details were studied the morine deposits of the Upper Jurassic(the separation scheme of which is adopted by us without alterations), more poorly studied continental deposits of Lower and Middle Jurassic time. The Cretaceous deposits of some sections earlier were subdivided up to stages, confirmed by paleontalogical data. In the same volumes they are singled out by us also. The deposits of Paleogene and Neogene were also under investigation, especially in the adjacent to the North regions. The Quatrnary deposits in such a detailed study are considered for the first time.

The further investigations on the stratigraphy for the first turn must touch upon the deposits of Paleozoic and Early Mesozioc time(including Jurassic deposits). These parts of the section on the territory of northern Afghanistan are remaining up to the present time, generally speaking, poorly studied yet. At the same time a number of such important

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questions as coal-bearing, prospecting for bauxites, refractory clayes and other kinds of mineral raw material are connected with a knowledge on paleography as well as on the conditions of sedimentation at the end of Paleozoic-first half part of Mesozoic time.

P R O T E R O Z O I C (?) G R O U P

The metamorphic formations of the Fulul series are related to the Proterozoic(?) time. Their proterozoic age is adopted conditionally on the grounds of high degree of metamorphism as a main.

The Fulul series

Metamorphic formations of the Fulul series have a distribution in the North-Eastern part of the region-at the lower and middle course of the Fulul river(fig.9) as well as at the middle course of the Ridi-Chal river (mainly in the basin of its right tributary-the Bazarak river).

Total area accupied by metamorphic rocks is not considerable-it amounts nearly 60 km^2.

At the down-course of the Bazarak river on the metamorphic rocks with sharp angular unconformity lay Upper Carboniferous - Lower Permian deposits. In rest of the cases the contacts of the metamorphic rocks with the Paleozoic deposits are tectonic onss.

The most widespread among the metamorphic formations are different by mineralogical composition gneisses, amphibolites and crystalline schis

At the middle course of the Fulul river (fig.8) the sequence of the considered deposits in general is supposed to be as follows:

At the lower part of the section dark gray micaceous and garnet-micaceous augen gneisses, the apparent thickness of which being 300-400m are outcropping. Above by the section concordantly lay gray and dark-gray with greenish tint anphibolites and almindine amphibolites, which have a thickness not less than 250 m. Further above come the greenish-gray thin-bended amphibole plagiogneisses, reaching not less than 500 m. in the thickness. Then come light-gray and light-pink quartzy-biotite micaceous crystalline schists with the apparent thickness being 300-400 meters.

All these metamorphic rocks have coarse-grained clearly pronounced gneissic structure. Their strucures are different and depend on their mineral composition. Micaceous gneisses(including those with garnet)as well as crystalline schists have lepidoblastic texture, rarely they have the elements of porphiroblastic texture. The amphibole-containing crystalline schists are differe for their granoglastic structure; only in some of them in consequence of lowtemperature columnar amphibole development appear the elements of nematoblastic and at some parts-poikiloblastic

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texture.

Micaceous gneisses and quartzy bimicaceous crystalline schists are composed by quartz,plagioclase,biotite(partly chloritizated),muscovite, microcline,sericite,saussurite,magnetite;sometimes there present amphibol apatite,tourmaline,sphene,zircone. In one case there ascertained a very little content of sillimamite in a form of little accumulation of thin acicules in oligoclase. In the garnet-contaning gneisses to these minerals added almindine also in the quantity of not more than 5%. The composition of plagioclase in gneisses ranges from the medium oligoclase up to medium andesine. Plagioclase is alternating into sericite,as in the main.

Biotite has a red-brown colour and apparently medium maltitude of ferruginazation. It has been replaced(negligibally as a rule) by pale-green,almost isotropic chlorite,for all this a non-considerable separation of leucocsene is taking place.

Muscovite usually developed in large plates;the ratio of the two mica is equal as a rule.

Magnetite,apatite,sphene,zircon,tourmaline are mainly met in the form of small rounded grains. Garnet is colorless,and forms small rounded removals.

Amphibolites are composed by amphibole,plagioclase,quartz,calcite, pyroxene(relics),saussurite,biotite,magnetite,sphene and apatite. The almandine amphibolites contain up to 10% of almandine. The composition of plagioclase in amphibolites is uneven: it ranges from the No.25 up to the No.70. Plagioclase is transiting into spotless saussurite aggregate. Amphibole is slightly colored in greenish or brownish tints with hardly noticeble pleuchroism ; in some cases it is almost colourless;usually it forms large oval grains. Magnetite often forms large irregular accumulations,in some cases it is overgrawn by sphene.

Garnet is noticebly coloured into reddish colour,forms rounded large grains with even margins and with numerous inclusions.

Amphibole plagiogneisses are composed by nests and scattered prisms of pale-green amphibole and by separate pseudomorphs of chlorite by biotite as well as by granular aggregates of quartz-plagioclase(andesine). Light minerals are the predominant ones. Plagioclase is usually replaced by aggregate of saussurite and sericite. Quartz forms nest-like accumulations,composed by oriented grains.

At the medium course of the Rudi-Chal river in the section of the Proterozoic(?) formations the gray,greenish-gray and in some interbeds-cherry-lilac,fine-grained biotite plagiogneisses are the predominant. In some places the rocks are schistose,banded,in some parts have massive texture and in such cases they are difficult distinguished from biotite granites,which are apparently in the form of stocks and veins everywhere cut the metamorphic formations.

Biotitic plagiogneisses have a granoblastic,rarely lepidoblastic texture and composed by large and small plates of biotite,usually chloritizated(sometimes it has been replaced by muscovite),rounded grains of serititizated plagioclase and large grains of quartz. Plagioclase apparently is quite asidic(oligoclase-andesine). In some cases small grains of garnet and epidote are met. Small scattered grains of magnetite are present.

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The rocks of the Fulul series on the whole area are unevenly metamorphosed. Recrystallization of the rocks took place in the conditions of high temperature of the almandine-amphibolite facies[x].

Considerable degree of recrystallization of the rocks is far more high than in the deposits of the Lower-Medium Paleozoic age, outcropping just at the same place; this fact testifyes to more ancient than Paleozoic age of the deposits of Fulul series.

The original character of the Fulul series deposits is ascertained not quite claarly. It is probable that among them the rocks of typically terrigeneous-sedimentary origin as well as effusive ones had a wide distribution. Intrusive rocks were apparently less distributed among them.

Total thickness of the Fulul series rocks exceeds I500 meters.

P A L E O Z O I C G R O U P

The Paleozoic deposits in the region under investigation have not wide distribution. They are outcropping on the area, involving approximately I400 km^2.

The Paleozoic deposits are separated into number of series, which have the local geographical denominations. As a base for the separation of the rocks into series put the differences in the lithological composition, discovered on the grounds of thorough petrographical investigations, observations on the character of the rocks metamorphism and other phenomena.

Below it is considered:

I) Lower Paleozoic deposits (Siyadarin series)
2) Deposits of the Sillurian and Devonian systems (the Durumbak serie
3) Deposits of the Upper division of the Devonian system (the Tundarin series);
4) Deposits of the Visei stage
5) Deposits of Middle and Upper divisions of the Carboniferous system (the Kalaimur series);
6) Undissected Carboniferous deposits (the Farkhar series);
7) Deposits of Lower-Middle Paleozoic, did not determined closely;
8) Deposits of the Upper divisions of the Carboniferous system and of the Lower division of the Permian system, undissected ones;
9) Deposits of the Sakmar stage;
I0) Deposits of the Sakmar and Artin stages, undissected ones;

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x) The separation of the metamorphic facies here and below is carried out according to F.J.Terner and others(I96I) on the basement of critical assosiations of minerals in pelitic, the most susceptable to metamorphism rocks.

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The Siyadarin series.

The deposits of the Siyadarin series are distributed in several remote one from another regions.

They are outcropping:

I) In the Central part of the region under investigation, in the basin of the Piez-Kul, Darkhab, Siya-Darra (the right tributaries of the Surkhab river) rivers; in the mountain massife of Durumbak, located to the West; in the region of the Doshi and Nakhrin villages.

2) In the North-Eastern part of the region under investigation, mainly in the basins of the right tributaries of the Rudi-Chal(Banki)-river of Rudi-Mandara, Isfanj and Hur-Darra.

3) In the South-Western part ofthe region under investigation, to the South from the village of Doaby-Mekhzarin as well as in the basin of the Saihan river.

The total area of the Siyadarin series' rocks outcrops m amounts nearly 360 km^2.

The deposits of the Siyadarin series have no stratigraphical contacts with more old formations. At their roof concordantly, rarely with scour and with stratigraphical unconformity lay limestones of the Durumbak series; in other cases they are with sharp unconformity overlapped by the deposits of Upper Triassiv or Cretaceous time.

The most favourable for studing of the Siyadarin series' deposi is the region of the Siya-Darra river's basin (fig.8, dr.2), wherewthere trinomial division of the deposits for the following below strata is ascertained:

I) Lower stratum of violet-green sandstones and schists with the thickness being 300-400 meters.

2) Middium stratum of greenish-gray sandstones, the maximal thickness being I00 meters.

3) Upper stratum of grenish-gray phillites, with the thickness being approximately 2000 meters.

The series of violet-green sandstones and schists is represented by alternation of monotonous by the composition sandstones and schists, coloured in bright gray-green and violet tints. The schists are predominant over the sandstones. Gray-green varieties of the rocks form interbeds with the thickness of 3-5 m. Sandstones, which are dividing the benches of alternating brightly coloured schists (30-60 m.) form interbeds from 0,5-5 up to I0 m. in thickness.

The rocks differ for extreamely low degree of metamorphism, corres-

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ponding to the conditions of the upper part of green schists'facies.

Schists quartz-sericitic,rarely clayey phyllite-like. They are composed by sericite,quartz,oxides of ferrum and of ore minerals or by hydromicae and kaoline only. Structure of the rocks is microgranoblastic or pellite micro-flaky one. Texture is schistose rarely massive one. Under a microscope the rocks are grey-gren,cherry with violet tint,rarely bluish-green,olive or pistashio-coloured,thin-bedded intensively crumbled,corrugated,with thin veinlets of quartz mainly located by cleavage.

Sandstones arkose or greywacke. They are composed by sharp-angular, rarely semi-rounded fragments of quartz,feldspars,jaspers and phyllites the dimentions of which being 0,2-I mm. Cement is quartz-sericitic basal one. Rarely(in the greywacke sandstones)cement is absent and instead of it small fragments of the rocks are observed. Texture of the rocks is blastopsammitic,inequigranular.

Megascopically the rocks are of green-grey colour,rarely of dark-violet,dark-grey almost black,they are dense,quartzite-like,medium-laminated,platty.

The stratum of greenish-grey sandstones is concordantly laying on the series of violet-green schists and sandstones and completely composed by interstratification of dark-grey and greenish-grey thick-bedded arkose and quartzy sandstones with rare subordinated interbeds of greywacke sandstones and phyllites.

Arkose and quartzy sandstones are composed by sharp-angular,rarely semi-rounded grains of quartz and feldspars the dimentions of which being 0,2-0,6 mm. Into a basal cement the small fragments of the same minerals,as well as flakes of chlorite,sericite sometimes of zoisite and of coaly minerals are included. Usual accessory admixture makes zirone and tourmaline. Structure of the rocks is blastopsammitic inequigranular sometimes lepidoblastic one. Texture is massive,sometimes (rarely) schistose.

Greywacke sandstones are analogical to those met in the underlaying deposits.

Phyllites are alike to those described below in overlapping deposits.

Series of greenish-grey phyllites is mainly composed by phyllites coloured into greenish-grey, dark-grey,rarely ash-grey or brownish-grey colours. The rocks are injected by quartzy veinlets,and have platty or foliated structure. At some places(especially frequent at the lower part of the section) an interstratification of phyllites and sandstones could be met. Sometimes among the phyllites the thin interbeds of quartzy porphyries and orthoschists,originated by acid and basic effusives are marked. More rarely one can trace lense-like interbeds with the thickness up to 50-80 m. composed by limestones light-grey,often brecciated and

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ferruginized ones (at the upper part of the section).

Regional metamorphism of the series is not high. Near the contacts with intrusions the phyllites are alterated into muscovite-albite-quartzy and biotite-muscovite-quartzy schists.

The phyllites are composed by small fragments of quartz and aggregate of chlorite, sericite and hydromica, which has replaced the clayey substance. In some rocks however kaoline is present. At some places an essential admixture makes calcite, oxidated siderite, leucocsene and limonite. Structure of the rocks is microlepidoblastic, rarely pelitic. Textu re is schistose, sometimes spotless for uneven distribution of chlorite.

Sandstones are analogical to those described in below laying series.

Quartzy porphiries are containing impregnations of quartz and oligoclase. In the ground mass the following minerals are observed: quartz, oligoclase, and common potash feldspar. Structure of the rocks is porphiric, the latter of the ground mass is felsitic.

Orthoschists on the grounds of the mineralogical composition and structure difference are divided into :

I. Aktinolite-epidotic schists (by basic effusives) are composed by epidote, actinolite and calcite. Structure of the rocks is microgranolepidoblastic. Texture is schistose one.

2. Epidote-calcite-quartz-feldspar schists apparently originated by the effusives of basic composition. They are composed by quartz and feldspars, calcite and epidote. Structure of the rocks is fine-grained, texture is foliated.

3. Muscovite-albite-quartzy schists (by asid effusives) have the following mineral composition: quartz, albite, muscovite, skapolite. In the rocks the relic porphyric impregnations of plagioclase are met the diame ter of them being I-2 mm. These relics are replaced by albite and skapolite. Structure of the rocks is blastoporphyric, texture is foliated,

Muscovite-albite-quartzy and biotite-muscovite-quartzy schists which are composed by grains of quartz, albite, flakes of muscovite and bi otite. Ore minerals such as rutile, apatite, zircone, sphene are also present here. Structure of the rocks is granolepidoblastic. Texture is foliated, sometimes thin-bedded.

In the strip of the deposits traced along the right slope of the Saihan river's valley in the section of the Siyadarin series the predomination of grey, dark-grey, greenish-grey, rarely violet-grey and light-green muscovite-quartzy, quartz-biotitic, chlorite-sericite-quartzy schists interstratificating at some places with dark-green actinolite-epidote-albitic, chlorite-albite-actinolitic and dark-grey muscovite-albite-quartz schists is quite clearly pronaunced.

In the Middle part of the section among the schists occur intraformational conglomerates, forming unpersistant along the strike interbed, the maximal thickness of which being I00-I20 meters.

Judged by the degree of metamorphism the most amount of the rocks of the Siyadarin series at the right slope of the Saihan river is related to quartz-albite-muscovite sub-fasies of green-schists' facies. Below their petrographical characteristic is given:

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Muscovite-quartzy schists are composed by grains of quartz,flakes of muscovite and biotite and by accessory minerlas:rutile,apatite,and zircone. Structure of the rocks is granolepidoblastic. Texture is foliated.

Quartz-biotite schists are met near the contacts with granitoides. Their composition is the following:biotite,quartz,plagioclase. Structure of th rocks is microgranolepidoblastic. Texture id foliated,sppotty.

Chlorite-sericite-quartzy schists are composed by quartz,sericite, chlorite. Structure of the rocks microgranolepidoblastic. Texture is foliated.

Actinolite-epidot-albite schists are characterized by the presence of albite,epidote,actinolite,chlorite,which are found in the equilibrium association,corresponding to albite-epidote-chlorite-actinolite sub-facies of the green-schists' facies. Besides them there are present calcite and sphene. Structure of the rocks is nematogranoporphyroblastic.Texture is foliated,

Chlorite-albite-actinolitic schists are composed by the same equilibrium association of minerals:actinolite,albite,chlorite,epidote. There are sphene and calcite present also. Structure of the rocks is micronematogranoblastic. Texture is foliated.

Muscovite-albite-quartzy schists are quite analogical to the described above.

Conglomerates are dense,coarse-laminated,noticebly metamorphosed. They are composed by medium-rounded fragments of 30-40 cm. in diameter; the fragments are composed by metamorphic and crystalline schists,jasper quartz,limestones of Paleozoic appearence,granites and sandy cement which is connecting these fragments.

At the North-Eastern part of the investigated region the lithological background of the Siyadarin series deposits is determined by greenish-grey,dark-grey,violet-grey,rarely black,different by composition and structure schists. In the main they are chloritizated quartz-albite-micaceous,amphibole-micaceous and amphibolic schists. There are met the essentially feldspar-quartzy,calcareous and coaly schists. The rocks are thin-medium-laminated,injected along the plains of schistose by quartz which forms veinlets up to I0-20 cm. in thickness.

At the medium part of the section among the schists the interbeds of schistose conglomerates(I5-20 m.) and of marbled limestones are sometimes could be observed. At the contact with limestones the schists are often hornfeled,and contain fine dense impregnation of pyrite.

At the upper part of the section at some places amphybolites are met,

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forming the benches being 50-60 up to I00 m. in the thickness and also limestones marbled ones of grey,dark-grey,rarely black coaly,alterating with schists and replacing them along the strike (fig.I0).

An apparent thickness of the deposits reaches I500-2200 meters.

By the degree of metamorphism the rocks are related to the upper subfacies of green-schists' facies. Below the petrographical characteristic of the most widespread rocks is given;

Schists have clearly pronounced foliated structure and fine-medium-grained lepidogranoblastic(micaceous schists),nematogranoblastic(amphibole schists),rarely granoblastic or mixed textures. Dark-coloured and quartz-feldspar aggregates are usually differentiated by layers. Biotite is almost completely replaced by pale-green,slightly pleochroic,almost isotropic chlorite. Amphybole is represented by both fibrous actinolite and by prismatically-grained aluminoferous lowtemperatural amphybole. Plagioclase is representing by itself mainly albite,and only in some cases -albite-oligoclase: it has been twined very bad as usual. It is replaced by sericite with different degree of intensity,sometimes with saussurite aggregate and clinozoisite. In some cases albite forms more large poiciloblasts,enclosing,as in the main,quartz. Magnetite is present in the form of fine scattered impregnation.

Conglomerates are composed by lolongated along the beddinf plains oblong-elipsoidal pebble of fine-grained quartzites;the pebble has a length of 2-3 up to I0-I5 cm.,the cross section of it being I - 4 cm., cement of it is represented by described above schists

Limestones are marbled with unclear linear texture,contaning lenses of quartzy fragmental material,mainly recrystallized;they are enclosing small nest-like accumulation of ore mineral.

Amphybolites are composed by pale-coloured low-temperatural amphybole,albite,epidote and magnetite;sometimes in low quantity quartz is present.

It was known very little about the age of the described metamorphic rocks.

Metamorphic schists of the right-bank area of the Saihan river were considered by G.Gaiden (I9II) in the composition of his Helmend series. Much later D.Veppert(I964) who studied them in details had noticed that some varieties of the rocks (micaceous schists with inclusions of garnets) were metamorphosed more stongly as the typical rocks of the Helmand series (clayey slates and quartzites). In connection with this the age of the crystalline schists' stratum was considered by him as Pre Paleozoic.

Metamorphic rocks of the Rudi-Chal river valley (crystalline schists of the Siyadarin series and marbles of the Durumbak series) were compared by K.Khintse (I964) with the deposits of"the calcareous schistose" series of K.Bruel(I935) developed at the up-stream of the Kokcha river valley. The age of metamorphic rocks was determined by him as Early Paleozoic or even Pre Cambrian.

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Organical remains in the dpposits of the Siyadarin series are not found yet. To the Lower Paleozoic they are related by us for their concordant -in the most number of cases- occurence under the Devonian (at the lower part apparently under Sillurian ones) deposits of the Durumbak series

For the most part the deposits of the Siyadarin series probably have the Ordovican age. As stratigraphical analogue of these rocks are probably the deposits of the Wiskharv series of the South-Western Darvaz, which occur concordantly under the limestones of the Sillurian and Devonian age (N.G. Wlasow,I96I) as well as the Ordovican deposits of the Kysyl-Jiik and Tuzguny-Tereskei ridges in the Eastern Pamirs (E.Ya.Leven, I960).

The accumulation of the Siyadarin series' deposits took place in several sub-latitudinaly oriented depressions,the most large of them were in the North and in the South of the territory. In connection with a pulsational character of the morine basin bottom movements during the early and late stages of the sedimentation the replacementof clayey material by sandy one took place. More intensive and stable downwharp took place durin the medium atage of the sedimentation process when predominantly sandy deposits accumulated here.

In the northern depresssion at the end of the sedimentation sycle in the morine basin bottom appeared fractures and in small scales fissured eruptions of lavae of basic and acid composition had been manifested. In the South during this time new areas of washdown appeared,where the Pre Paleozoic rocks which underwent metamorphism and emplacement of intrusions had been eroded. Their pebble in abundance is met in the lenses of intraformational conglomerates,occuring among fine-fragmental rocks. By the end of the Siyadarin time an amplitude of the downwarping was sharply decreased. The filled by sedimentations southern downwarp,apparently was dryed out.

SILLURIAN AND DEVONIAN SYSTEMS,UNDISSECTED

The Sillurian and Devonian deposits are singled out in the Durumbak series. The Devonian age of the deposits of the upper part of the section is definitely ascertained. The lower part of the section apparently partly involves the Sillurian system also. That is why the age of the united Durambak series is conditionally adopted by us as Sillurian-Devonian one. Besides it the Devonian age apparently has the lower part of the considered further Tundarin series.

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The Durumbak series

Spatially the outcrops of the Durambak series' rocks are closely connected with the outcrops of the Siyadarin series' deposits. The rocks come to the day surface in the form of picturesque,often inaccessible cliffs,the bulks of which are sharply elevated on the background of the surrounding medium mountain area.

The most substantial outcrops of the Durambak series' rocks are situated in the North-Eastern part of the investigated region. Here they are outcropping at the western slopes of the Kukhi-Namakab mountains,in the basin of the Banhi river (Rudi-Chal) near the villages of Anhurak, Danai-Shira and Bazarak,to the North from the pass of Kotali-Chal as well as at the North-Western slopes of a nameless ridge,outlining from the South-East the Ishkamysh depression. In the Central part of the investigated region they are exposed in the mountain massif of Durumbak as well as in the basins of two large tributaries of the Surkhab river-the rivers of Siya-Darra and Darkhob. The most large outcrops of the described deposits have been fixed in the South-Westrn part of the investigated territory at the slopes of the Surkhab river valley between the village of Doabi-Mekhzarin and the mouth of the Saihan river also. Total area of the outcrops of the Durumbak series' rocks in the investigated region amounts approximately 370 sq.km.

The contacts of the Durumbak series' deposits with the underlying rocks of the Siyadarin series are often compicated by tectonic displacements running along the contact for the different competenteness of the rocks. In most number of cases the rocks of the Durumbak series are gradually replaced by the terrigeneous deposits of the Syiadarin series. Only near the mouth of the Saihan river they supperimpose the underlying deposits with local wash-out and with stratigraphical unconformity.

The roof of the Durumbak series in the region of the Lorak village, located in the basin of the Fulul river is formed by concordantly laying Upper Devonian-Lower Carboniferous deposits of the Tundarin series. In the vicinity of the Doabi-Mekhzarin village and the mouth of the Saihan river the limestones of the Durumbak series are transgrassively overlapped by the deposits of the Visei stage of the Lower Carboniferous age.

The predominant in the section of the series are limestones,yielding the place to marbled limestones and marbles in the eastern regions of the territory. Carbonaceous rocks are divided in the section by interbeds (from 3-5 up to 8-100 m.) of greenish-grey or dark-grey phyllites,aleurolites or quartz-albite-micaceous schists. Among these rocks at the lower and medium parts of the section at some places the lenses and interbeds of

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black-green plagioclase gialoliparites and plagioporphirites(the thickness of which being up to 20-30 m.) are traced. More rarely among the limestones interbeds of grey-green fine-pebbled conglomerates(2,5-6 m.) and gravellites are met.

Below the petrographical characteristic of the most characteristic rocks is given.

Limestones are of grey,dark-grey,rarely of white,by separate spots of yellow or pinkish-grey colour,dense,unclearly bedded,often fine-grained,rarely of cryptocrystalline texture,in some places stripped,pierced by dense net of calcitic veinlets. In separate interbeds the limestones are orogenic-detrial,crinoide ones. In some places they have breccia-like or cob-like structure. The most widespread among the limestones are the following three varieties:

I. Nodular limestones,composed by round-shaped concretions of fine-grained calcite with diameter of 0,5-I,0 mm. as well as by more large grains of the same calcite,playing a role of cement. They have a nodular structure.

2. Breccia-like limestones are composed by sharp-angular fragments of limestones,cemented by calcite and by small admixture of quartz grains(up to 5%). Structure of the rocks is breccia-like,cryptocrystalline.

3. Sandy limestones are composed by even mosaic of grains of calcite with little admixture of sharp-angular grains of quartz (up to 8%), the dimentions of which being 0,3-0,8 mm. Structure of the rocks is fine grained,rarely cryptocrystalline.

Marbles are medium-coarse-grained have clearly pronoumced linear texture and contain non-considerable quantity of quartzy material.

Plagioclase gialoliparites are containing in their composition intergrowths growths of oligoclase crystalls with the diameter I-3 mm., which play the role of porphyry separations.The ground mass is representing by itself a green almost uncrystalline volcanic glass. Structure of the rocks is porphyritic,the latter of the ground mass is hyaline.

Plagioporphyrites are containing in their porphyry separations the sharply zonal crystalls of andesine,the diameter of which being I-3 mm. and crystalls of amphybole almost completely replaced by chlorite.The ground mass is representing by itself a felsite. The texture of the rock is porphyritic.

Gravellites are composed by rounded fragments of quartzites,rarely of jaspers(3-5 mm.) and by basal chlorite-quartzy cement,into the composition of which often come such minerals of contact metamorphysm as diopside and epidote. The texture of the rocks is psephitic.

In the North-Eastern part of the investigated territory in the valley of the Shar-Shar river approximately I0 km. off to the South from the Ishkamysh village the following section of the Durumbak series' deposits has been described(from the bottom,fig.II,I2):

I. Limestones light-grey,bluish-grey medium-fine bedded marbled with strong smell of hydrogen sulphide.....200-300m

2. Limestones dark-grey thinplatted in some interbeds are medium-bedded,marbled,at the upper part with interbeds (2-5 m.) of quartz-albite - micaceous schists..... I00-I20m

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3. Schists grey and dark-grey medium-laminated of quartz-albite-mica composition. At the lower part of the bench the schists are predominantly black thin-laminated, sometimes containing interbeds of grey medium-laminated limestones, the thickness of which being 4-5 m.... 80-I00 m.
4. Limestones grey thick-platted marbled. At the upper part of the bench there are interbeds of black and dark-grey thin-platted limestones..... I20-I30 m.
5. Schists dark-grey thin-stripped quartz-albite-micaceous ..50-60 m.
6. Limestones grey thick-bedded marbled, soft..... I0-I2 m.
7. Limestones grey thin-bedded (4-I2 cm. up to 0,5 m.) with thinnest interbeds of schists..... . 60-80 m.
8. Schists dark-grey foliated and thin-bedded of quartz-albite-mica composition. At the upper part of the bench there are thin (up to 0,7-0,8 m.) interbeds of light-grey thin-bedded limestones ..... 20 m.
9. Limestones grey fine-medium-bedded, at some places- schistose and marbled. In the form of rare interbeds black stripped quartz-albite-micaceous schists are met ..... nearly 200 m.
I0. Limestones grey and light-grey stripped thin-bedded, marbled. They are outcroppping at the upper-streams of the Shar-Shar river valley..... not less than300m.

The lower part of the Durumbak series' deposits is exposed near the Danai-Shira village, by the Shulesh-Darra river, in the region of the Kotali-Safed pass(fig,I0) as well as in another places, where the underlaying deposits of the Siyadarin series are ascertained. It is represented by a bench of dark-grey thin-bedded limestones of unstable thickness (30-40 up to 250 m.) and by the overlapping thick stratum of light-grey and white marbled limestones and marbles. Sum thickness of the Durumbak series' deposits in the North-Eastern regions reaches I500 -I600 meters.

In the Central part of the investigated territory in the basins of the Siya-Darra and Larkhob river (the right tributaries of the Surkhab river) as well as in the mountain massif of the Durumbak in the section of the Durumbak series' deposits the main importance have unclearly bedded limestones. At the lower part of the section among the limestones in some parts the interbeds (up to 40-50 m.) of black phyllites and calcareous aleurolites, inside which sometimes the lenses and interbeds of black-green plagioclase gialoliparites and their lavobrecciae are traced.

At the medium part of the section in the basin of the Siya-Darra river in the limestones the crinoideae of Pentagonoryclicus ex. gr. planus Schewtchenko(in litt) were met, which are characteristic for

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the Koblents-Eifel stages of the Lower-Middle Devonian age. Up-stream the mouth of the Durumbak river the limestones besides it contain stripes of Rucalyptocrinites sp.,Crotolocrinites sp.,Pentagonocyclicus anulus (in litt) Schewchenko,known only in the deposits of the Koblents stage (determinations made by T.V.Schewchenko).

An apparent thickness of the Durumbak series' deposits in the Central regions of the investigated territory is is also considerable one-nearly I000 m.

In the South-Western part of the investigated territory at the downstream of the Saihan river near the Doabi-Mekhzarin village,the limestones of the Durumbak series are lying on the underlying metamorphic schi: of the Siyadarin series,but there are no angular unconformities observed here.

At the basement of the stratum of the limestones usually lies the bed of conglomerates,the thickness of which being up to I0-I5 m. Analogical conglomerates in the form of horizons being 30-35 m. in thickness are marked besides it among the limestones at the lower part of the stra tum's section. Conglomerates both basal and intraformational ones are deprived of pebbles of underlying rocks and completely composed by poorly rounded fragments (with the diameter of the latter being 20-30 cm. of limestones,enclosing them. But the cement of the rocks is black and grey-green sandy apparently contaning finely fragmental material from the underlying deposits.

More rare and more thin (2,5-6 m.) among the limestones are the interbeds of grey-green gravellites and finely pebbled conglomerates,composed by fragments of quartzites,crimped and silicificated phyllites and sometimes by plagioporphyrites.

The roof of the Durumbak series' limestones in the mentioned regions is formed by transgressivley occuring deposits of the Visei stage of the Lower Carboniferous age.

At the medium part of the section among the limestones the poorly preserved Thumnopora sp. were met, belonging according to the prelimenary determination by T.V.Dobrolubova probably to the Devonian age[x].

Within the limits of the South-Western Darvaza (USSR) the series of reefogeneous limestones under the denomination of " Dikzankov series" had been described (N.G.Wlasow,I96I;A.Kh.Kafarski,I963) in which the deposits of the Lower Sillurian age (beginning from the Lower Landoverian ones),of the Upper Sillurian and all the divisions of the Devonian age are singled out.

x) As it was pointed out D.Veppert(I964) had related the series of the Sillurian and Devonian limestones of the Doab-Saihan area to the Permian age. He uncorrectly parallelized it with the "fusuline limestones" of G.Gaiden (I9II) and with "the Permian limestones of Bulola" singled out by Tompson (I946).

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This stratum apparently could be considered as a stratigraphical analogue of the Durumbak series' deposits. More low stratigraphical situation of the latters with respect to the uncofordantly lying deposits of the Visei stage as well as the presence of the Lower-Middle-Devonian fossils among the Middle part of the section all these facts are quite determinly testify to the Devonian age of the upper part of theses deposits' section. Paralelization of the Durumbak series' deposits of the investigated region with the deposits of the Dikzankov series of the South-Western Darvaza allow to speak on the Sillurian age of the Lower part of the section.

Poor collection of organic remains do not allow to dissect the deposits of the Durumbak series so detailly as it was sucseeded to do in the limits of the South-Western Darvaza so far,but in the future,as it is supposed, it will be possible.

Accumulation of the Durumbak series' deposits took place in the slow deepening opened morine basin. During a prolong period of time the conditions of sedimentation were almost the same. The formation of limestones was replaced by sedimentation of sandy-clayey material during short periods of time only.

In small scales during the primary stages of the sedimentation (apparently during the Sillurian time) the submarine interfluents of acid and basic composition lavae flows took place.

The appearence of the itraformational horizons of conglomerates, composed by fragments of enclosing limestones in the sections of the Doab-Saihan region testify apparently to the appearence of islands near which these conglomerates had been accumulated.

Upper division of the Devonian system-Lower division of the Carboniferous system

The deposits of the Upper Devonian and Lower Carboniferous divisions are singled out as Tundarin series. Its deposits arenot characterised by organic remains. The age is ascertained according to the situation in the section. At the roof of the Tundarin series with washout lie the rocks of Visei stage;simultaneously the Tundarin deposits are the most yong as compare to the limestones of the Durumbak series.

The T u n d a r i n series

The deposits of the Tundarin series are distributed not very wide. They are outcropping on the area of nearly 330 km^2.

The main their outcrops are consentrated in the Central part of the investigated region,where they are exposed at the two slopes of the Saidi-Kaen river,at the up-stream of the Shuljukta,Tun-Darra,Kalaimurat,

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Sary-Kainar and Jau-Palal rivers coming out in erosional windows on the backgrounds of continuous field of the Cretaceous and Paleogene deposits' development. Small outcrops of the Tundarin deposits are singled out in the north-eastern part of the investigated region as well as to the South from the Kotali-Chal pass,at the up-streams of the Mush-Khona sai (the right tributary of the Darra-i-Kolon river),in the region of the Lorak village,situated in the Fulul river valley.

The roof of the Tundarin series' deposits form the deposits of different age lying with washout and anconformity-the deposits from the Vise up to the Upper Cretaceous ages. On the deposits of the Durumbak series the Tundarin ones lie ~~m~~concordantly.

The main role in the composition of the Tundarin series play quartz-muscovite,quartz-biotite metamorphic schists as well as muscovite-albite-quartzy otthoschists originated as a result of acid effusives acting.

Here interbeds of marbled limestones and marbles being in thickness from 30-40 up to I00-I20 meters as well as interbeds of albite-actinolite and chlorite-epidote-quartzy schists,micaceous quartzites and greywack sandstones being I0-20 m. in the thickness are characteristic. At some places in the form of horizons being I0-20 up to 50-I00 m. in the thickness among the deposits of the series quartzy porphyries,plagioporpyries and amphybole porphyrites are observed. In separate cases in the section appear amphybolites,forming interbeds up to 30 m. in the thickness or interstratificating chlorite-albitic and serpentine rocks.

In separate outcrops in the North-East of the region the structure of the Tundarine series is somewhat different. In the section the dark-grey,olive-grey,ash-grey,rarely -grey-green and black thin-platted quartz-albite-micaceous schists are the predominant. At the lower part of the section they often interstratificate with grey thick-medium-laminated, in some cases thin-laminated coaly limestones and greenish-grey amphybolites and amphybole schists. Rarely here the horizons of black quartzy sandstones and green chlorite schists are observed. Sometimes lodes of serpentinites are met. At the upper part of the section of schists met interbeds of white,grey and dark-grey thin-stripped quartzites(2-I0 m.).

Below a petrographical characteristic of the most characteristic rocks is given.

Quartz-muscovite and quartz-biotite schists are composed by grains of quartz and abundunt flakes of muscovite,biotite and chlorite. In the form of admixture an organic matter is met as well as ceisite,rutile,apatite,zircone and newly formed tourmaline. Very seldom in the composition of the rocks comes almandine,forming porphyroblasts with the diameter of 0,5-I,0 mm. Structure of the rocks is granolepidoblastic, texture is foliated,stripped.

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Muscovite-albite-quartzy orthoschists originated by acid effusives, are composed by quartz,albite and muscovite. Rarely in the composition of the rocks come the following minerals:biotite,microcline,pertite,calcite,ore mineral,graphite and apatite. The rocks are strongly foliated, but in the most number of cases the relics of plagioclase,replaced by albite are observed. Structure of the rocks is relic porphyroid(blastoporphyric) in some places -milonitic one. The ground mass has secondary granolepidoblastic structure.

Quartz-albite-micaceous schists contain in their composition the following minerals: biotite,muscovite(sericite),chlorite,albite,quartz, epidote,magnetite,sphene,calcite,apatite,zircone,coaly substunce(partly apparently graphite) and sometimes -garnet. Structure of the schists is lepidogranoblastic;with the increasing of mica amount it is approching to the lepidoblastic one,with the decreasing of mica amount-to granoblastic one.

The ratio of the two micae in the rocks is equilibrium one. Muscovite forms flaks which are more large of those formed by biotite. Overgrouth of biotite by muscovite is observed extreamely seldom,the replacement of biotite by pale-green almost isotropic chlorite is more characteristic,biotite is brown or greenish-brown,comparetively pale-coloured (slightly ferruginized). The micae often separating in the rock, in theform of separate strips and interbeds.

Quartz is forming a medium-grained aggregate,evenly or by lenses distributed in the rock,usually together with albite,from which it is difficult distinguished.

Albite side by side with quartz-like granular aggregate often forms small porpyroblasts,it is twined simply or is not twined at all. Usually it is infected by eruption of fine sericite,saussurite or epidote.

Magnetite forms irregular graines and segregations,very seldom- organogeneous crystalls. Calcite is present in the form of interstitial separations,in some cases its content reaches 30-50%. Garnet is represented by colorless or slightly pink spessartine;often it is corroded by colourless chlorite.

Marbled limestones and calcitic marbles are composed by calcite with little admixture of quartz. Structure of the rocks is granoblastic. Sometimes limestones have a sharply pronounced linear texture and contain a considerable amount of fine-grained quartz and sometimes flakes of coaly substunce. These admixtures often arrange stripply.

Albite-actinolite schists have the following mineralogical composition: actinolite,albite,calcite,ciosite,epidote,quartz,ore minerals and sphene. They were apparently formed by effusives of medium-basic composition. Structure of the rocks is granonematoblastic,texture is foliated rarely massive one.

Chlorite-epidote-quartzy schists are composed by quartz,epidote and chlorite. Structure of the rocks is granoblastic. Texture is foliated.

Chlorite schists are composed by colorless slightly birefrigening chlorite and by nest-like irregular separations of magnetite. They have a nematoblastic structure and linear texture.

Quartzites for 95% are composed by allotriamorphic grains of quartz as well as by rare irregulary dissiminated grains of magnetite and parallel-oriented leaflets of mica. Structure of the rocks is lepidogranoblastic.Texture is foliated.

Greywack sandstones are composed by sharp-angular fragments of quartz feldspars,jaspers,phyllites and more small fragments of the same rocks, playing the role of cement. Structure of the rocks is psammitic inequigranular.

Quartzy porphyries contain in their porphyric separations the melted crystalls of quartz the diameter of which being I-4 mm.;in the ground mass there are quartz,and sericite developed by feldspars. Structure of

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the rocks is porphyritic, the latter of the ground mass is relic granulitic one.

Plagioporphyries are composed by the seggragations of feldspar, completely replaced by sericite and calcite as well as by rare seggragations of dark-coloured minerals, completely chloritizated. Structure of the rocks is relic porphyry one, the latter of the ground mass is phelsitic.

Amphybole porphyrites in their porphyritic seggragations contain amphybole; the ground mass of the rocks is composed by plagioclase, amphybole rarely by epidote. Structure of the rocks is porphyric, the latter of the ground mass is unclear-granular.

Amphybolites are composed by amphybole, oligoclase, epidote, ilmenite, sphene. The grains have the dimentions of 0.3-I.0 mm. Structure of the rocks is granonematoblastic. Texture is stripped, conditioned by alternation of strips, composed by the predominant oligoclase with strips enriched by amphybole (and by epidote).

Chlorite-albitic rocks are composed by albite, chlorite and calcite. Albite is observed in rouned crystalls without polysintetic twins. Structure of the rocks is granoblastic one. Texture is massive.

Serpentine rocks (serpentines) have a micro-flaky structure and completely composed by antigorite, or composed by spicular, differently oriented crystalls of serpentine(chrizotile) and platty grains of ore mineral situated by chains.

At the left slope of the Saidi-Kaion river valley, at the up-stream of the Tun-Darra, Kalaimurat, Shulukta rivers in the section of the Tundarin series the metamorphic schists are essentially predominant by their composition being quartz-muscovite and quartz-biotitic ones and in outward appearence are undistinctive from them the muscovite-albite-quartzy orthoschists, originated by asid effusives. The rocks of grey, dark-grey, greenish-grey colour, thin-bedded, silky, leaf-by-leaf injected by quartz. Among schists and effusives the interbeds of greenish-grey greywack sandstones and the beds of dark-grey micaceous quartzites are observed. Rarely the rocks enclose the interbeds of white, light-grey, dark-grey banded limestones, in some places alterated into marbles the thickness of which being 30-40 up to 80-I00 m. At the left slope of the Saidi-Kaen river the bench of marbles is underlyed by the 30-metric interbed of amphybolites. Lenses of amphybolites being of irregular form are met among the mables also. In some places in the form of isolated horizons (I0-20 up to 50-I00 m.) among the mentioned rocks the dark-grey and dark-green medium banded dense quartzy porpyries and albite-actinolite schists are observed. The thickness of the deposits in these regions is the greatest ones and apparently exceeds 2500 meters.

At the right slope of the Saidi-Kaen river the predominant in the section of the series rocks are the light-green effusives of acidic composition(alterated and transphormed into muscovite-albite-quartzy schis and into dark-green amphybolic porphyrites. Everywhere among these rock the benches of up to 80 m. in thickness of quartz-muscovitic and quartz-biotitic schists are present. At some places the interbeds (up to I0 m.)

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of albite-actinolite or of chlorite-epidote-quartzy schists are observed. The beds of marbled limestones of white and dark-grey colour are met extreamly rare. The observed thickness of the stratum here does not exceed 500 meters.

At the up-streams of the Sary-Kainar river the section of the Tundarin series' deposits is subdivided into two parts:

I. The lower one, composed by dark-green serpentine rocks (serpentines ?) and by chlorite-albite rocks, originated probably during the metamorphism of the alkiline effusives of albitite type with the apparent thickness being 200-300 meters;

2. The upper one, composed by dark-grey muscovite-albite-quartzy orthoschists with subordinated interbeds of marbled limestones and metamorphic quartz-muscovite and quartz-biotitic schists, with an apparent thickness being 800-I000 meters.

At the up-streams of the Jau-Palal river in the section of the series the schists of grey and dark-grey colour, at some places interstratificating with grey marbled limestones in which the recrystallized columnals are sometimes met, are the predominant. Rarely in the section the interbeds of plagioporpyries could be met.

In the North-East of the region, 2 km. to the East from the Lorak village by the valley of the Khushk-Darra river the lower horizons of the section are described. They are outcropped at the western wing of an anticline, composed by limestones of the Durumbak series. The stratigraphical sequence of the Tundarin series' deposits here is the following (from the bottom):

I. Schists grey quartz-albite-micaceous ..... 40-50 m.

2. Limestones grey medium-banded with horizons of dark-grey thin-banded coaly limestones. At the upper part of the section the foliated at the beded surface micaceous limestones are met.....nearly 200 m.

3. Sandstones black medium-banded predominantly quartzy..... 70 m.

4. Limestones of grey colour marbled, unclear-banded.....nearly40m.

5. Amphybolites, amphybole schists, greenish-grey foliated with interbeds of quartz-albite-micaceous schists..... nearly 200 m.

6. Schists light-grey and greenish-grey of muscovite-chlorite-quartz composition strongly calcareous..... 40 m.

7. Further by the section near a fracture the grey unclearly-banded marbled limestones are outcropping..... 30-40m

Total thickness of the described deposits amounts 620-640 mt

The upper part of the section is formed by quartz-albite-micaceous schists with rare interbeds of quartzites, which are outcropping directly

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near the village of Lorak as well as to the West of it in sai karies of Islam-Darra and Tutak. Approximately the thickness of the upper part of the series' deposits could be estimated as to be 800-I000 m. Summary apparent thickness of the mentioned series' deposits in the region of the Lorak village reaches I600-I800 m.(fig.I3).

In the regions situated to the South from the Kotali-Chal pass the contact of the Tundarin series' deposits and of the Durumbak series has a shrp and clear character. At the contact of marbles and schists here the bed-like lodes (up to 2 m. in the thickness) of skarned and quartz-calcitic rocks,in which an impregnation of galena sometimes is met,are quite often could be observed.

From the given characteristic of the Tundarin series' deposits in the North-East of the region one can see that among them effusives, playing an important role in the composition of the series of the Central part of the investigated territory are more seldom met.

An isolation of regions with the outcrops of the Tundarin series' deposits,an absence of stratigraphycally complete sections,of reference horizons and an absence of fauna,as well as compicated conditions of occurence all this makes it difficult to study these regions and their stratigraphy. On the grounds of the present factual material one can only suppose that the rocks described at the right slope of the Saidi-Kaion river valley as well as at the up-streams of the Sary-Kainar river are the most old ones than those outcropping at the up-streams of the Tun-Darra,Kalaimurat,Shulukta rivers and those outcropping at the left slope of the Saidi-Kaion river,where in some places at their roof the Visei deposits lay with a washout.

The series exposed at the up-streams of the Jau-Palal river are apparently involve the middle part of the Tundarin series' deposits.

The deposits of the Tundarin series on the grounds of their situation in the section between the deposits of the Visei stage of the Lower Carboniferous and the limestones of the Durumbak series of the Sillurian-Devonian age,are related to the Upper part of the Upper Devonian and to the Lower parts of the Lower Carboniferous age (Turnei stage).

In the western Afghanistan (Herat province) the same by age deposits ,according to our viepoint,are the volcanogeneous-sedimentary formations of the Middle Paleozoic,laying under the faunistically characterized deposits of the Palavan series,which are containing organic remains of the Upper Turne,Vise and Namur(K.Ya.Mikhailov and others,I965).

At the South-Western Darvaza within the limits of the USSR as a stratigraphical analogue of the Tundarin series' deposits are apparently the sedimentary-volcanogeneous formations of the Kalaikhumb series with

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a washout and unconformity lying on the limestones of the Dikzankou series of the Sillurian-Devonian age(N.G.Wlasow,I96I).

Accumulation of the deposits of the Tundarin series took place in the conditions of great mobility of the territory what is confirmed by a continuous effusive activity (fissured eruption) during the Tundarin time (in the Central part of the region). A downwarp in which the sediments were accumulated had inherited a sublatitudinal orientation from the more ancient times. The ablation areas limited it from the North and from the South. In the North-East of the territory an acumualation of sediments took place apparently in a separate basin with a more stable regime,manifestations of volcanism are not marked. By the end of the Tundarin time the amplitude of the marine bottom's downwarping apparently was decreased,an effusive activity came to a standstill and in the Central part of the region by the beginning of the Visei age at the place of doenwarp a land appeared.

C A R B O N I F E R O U S S Y S T E M

The Carboniferous deposits within the limits of the investigated territory are limitedly developed. Among them several subdivisions are ascertained by us. Besides the described Tundarin series (Upper Devonian -Turne stage of the Lower Carboniferous)- here are the Visei stage,Kalaimurat series (Middle-Upper Carboniferous) and Farkhar series (undissected Carboniferous).

The V i s e i stage

The deposits of the Visei stage are marked in several places: near the villages of Doabi-Mekhzarin,at the mouth of the Saihan river,at the down-stream of the Amir-Omad river(the left tributary of the Surkhab river),at the Middle part of the left slope of the Saidi-Kaion river valley as well as at the up-streams of the Kalaimurat river on the area of 20 sq. km. With a deep washout and stratigraphical unconformity the rocks of the Visei stage are lying on the deposits of the Durumbak or of the Tundarin series and also transgrassively with an apparent angular and azimuthal unconformity are overlapped by the deposits of the Kalaimurat series or by the deposits of the Upper Triassic age.

The found fossils allow to determine the age of the considered deposits as a Viseian one.

Two types of these deposits' sections are known:the Southern (Doabi-Mekhzarin,Saihan,,Amir-Omad),composed by argillites and aleurolites with interbeds of limestones,sandstones,gravellites,conglomerates,and the Northern one (Saidi-Kaion,Kalaimurat),completely formed by limestones.

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Below the petrographical characteristic of the most widespread rocks of the Visei stage is givem.

Argillites black, thin-bedded, containing a fine-dusted substunce and non-considerable admixture of aleurite quartzy particles.

Aleurites black, dark-grey, composed by clayey material, quartz and calcite. Structure of the rocks is aleuropellitic. Texture is massive.

Limestones dark-grey, black, rarely of pink and white colour. They are medium-thin-bedded, rarely thick-bedded, fine-grained, sometimes they are lumpy, speckled with veinlets of calcite; limestones often contain small well rounded pebbles of milky-white quartz.

Sandstones are of greenish-grey, tabaco-grey, grey colour, thin-medium-bedded, fine-medium-grained, polymict or arkose ones.

Conglomerates and gravellites are grey, greenish-grey, composed by medium-and fine rounded pebbles of grey porphyries, metamorphic schists, sandstones, limestones, rarely of micaceous quartzites, jaspers and quartz. Average size of the pebbles in conglomerates is 3-6 up to I0-20 cm., in gravellites it is 0,3-0,5 cm. The cement is sandy, rarely carbonaceous with an admixture of muscovite flakes.

Below the most characteristic leaf-by-leaf sections of the Visei stage's deposits are given.

At the mouth of the Saihan river at its left bamk the lower part of the Visei stage's deposits is exposed. The Visei deposits here are lying with a washout on an uneven surface of the Sillurian-Devonian limestones of the Durumbak series and they include (from the bottom):

I. Conglomerates grey, medium-pebbly, replacing along the strike by limestones black, platty ones with Dibunophillum(?) sp., Lonsdaleia sp.nov. of the Vise-Namur age (determination by I.V.Pyzhianov).. app.3 m

2. Argillites black with interbeds of sandstones grey, platty ones (0,I-0,5 m.), conglomerates grey gravel-pebbly (up to I,5 m.) and limestones black platty (0,2-0,8 m.). At the medium part of the section in an interbed of limestones the Lonsdaleia sp.nov. of the Vise-Namur age was met and Giganto productus sp., which is apparently characterizing the Vise stage (determinations made by I.V.Pyzhianov and S.S,Karapetov) up to ..... 70-80 m.

Above transgrassively with angular (up to 30°) and noticeble azimuthal unconformities lay basal conglomerates of the Uppwer Triassic age.

More high horizons of the Visei stage are outcropping near the village of Doaby-Mekhzarin (fig.I4). The lower horizons of the section here are cut by a fracture, at the southern wing of which the limestones of the Durumbak series are outcropping. At the northern wing the following section could be observed (from the bottom):

I. Argillites black thinbedded, at the upper part with interbeds of gravellites greenish-grey calcareous ones, the apparent thickness of these deposits is..... 30 m.

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2. Sandstones of greenish-grey colour with interbeds of gravellites, the thickness is ..... 20 m.
3. Limestones black, platty, intensively silicificated, at the roof they are ferruginized ..... I0 m.
4. Above with a washout the conglomerates of greenish-grey colour with separate lenses of green sandstones are lying..... I5 m.
5. Limestones at the lower part are platty with a smell of sulphide hydrogene, at the uppper part are pink, or grey, disturbed by a great number of fissures, filled by calcite..... ..... 20 m.

In the limestones of the bed "5" Dibunophyllum turbinatum Mc.Coy, Palaeoamilia sp., Lonsdaleia sp.nov., Lithostration sp.nov. were met which are characteristic according to the conclusion of T.V.Dobrolubova for the Visei stage of the Lower Carboniferous age.

Total apparent thickness of the described deposits amounts ..95 m.

The roof of the described section is formed by basal conglomerates of the Upper Triassic lying with a washout.

At the mouth of the Amir-Omad river the deposits of the Visei stage are transgrassively overlapping a small stock of plagiogranit-porphyries Stratigraphically from the bottom their section is the following:

I. At the basement of the section the greenish grey fine-medium-pebbly conglomerates (in prbbles are metamorphic schists, sandstones and veine quartz) are lying alternating with gravellites and grey fine-grained sandstones. At the lower part of the bench interbeds of grey thin-platty limestones are maked.....up to 70-80 meters.

2. Limestones dark-grey medium-bedded with remains of solitary corals.....8-I0m.

3. Aleurolites and argillites of greenish-grey colour with interbeds of gravellites and limestones..... nearly 20m.

4. Alternating of limestones of dark-grey colour and aleurolites of greenish-grey colour..... Io m.

5. Limestones of dark-grey colour, medium-platty with fine pebbles of white quartz. In the limestones small corals and productides are met, the thickness is ..... nearly 40 m.

6. Aleurolites of dark-grey colour with interbeds of limestones, the thickness is ..... I0m.

7. Limestones of dark-grey colour being predominantly medium-bedded, Among the limestones crinoidea and colonial corals are met.....7-8 m.

8. Interstratification of sandstones of light-brown colour and grey sandy crinoide limestones. Sandstones are the predominant. At the lower part of the section interbeds of flinty slate ..... not less than I00m.

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The above lying horizons of the section are cut by a fracture. Out from numerous organic remains, collected in the described section, at the present time the only Diphyphyllum sp., is determined, which is characteristic according to the conclusion of I.V.Pyzhianov for the Lower Carboniferous age. Here also Campophyllum aff. amplexoides stuck are determined which have the Lower-Medium-Carboniferous appearence (determination made by T.A.Dobrolubova). Total thickness of the Visei deposits in the described section amounts 265-278 meters.

At the up-streams of the Kalaimurat river at the left slope of th Saidi-Kaion river valley the section of the Visei stage deposits is completely made up by limestones of dark-grey, grey, rarely of white colour, being thin-bedded, up to medium-bedded, often organogeneous-detritus ones with a smellt of sulphide hydrogene. On the underlying deposits the stratum of the Visei limestones occurs with a deep washout and with a stratigraphical unconformity, having sometimes at the basement a bed of conglomerates, being several meters in the thickness. Also with a washout, at some places with apparent angular (up to 20°) and azimuthal unconformity the limestones of the Visei stage are overlapped by the deposits of the Kalaimurat series.

Maximal thidness of the Vise deposits amounts 350-450 meters.

At some places the deposits of Visei stage arecompletely cut out by the overlapping deposits of the Kalaimurin series occuring with a washout.

The age of the deposits is dated by the found in them fossil remai of corals. They were determined by I.V.Pyzhianov as Lonsdaleia duplicata Mart., Dorlodotia sp., Dibunophyllum sp., Lonsdaleia sp. nov. and were considered to be characteristic for the Vise-Namur stages.

As it could be seen from the given descriptions, the lithological composition as well as the thickness of the deposits in the investigate region are noticebly changing. In the southern part of the region in the sections the terrigeneous rocks, the apparent thickness of which does not exceed 280 meters are essentially the predominant ones. In the northern regions the terrigeneous rocks are replaced by carbonaceous ones; the thickness of the deposits (the apparent one) is encreased up to 350-450 meters.

In the southern regions accumulation of the Visei deposits took pla ce on the background of gradually changing depth of marine basin and of monentary upliftings, which lead to the formation of islands. To this fact the particolored lithological composition of the deposits as well as intervals in the sedimentation testify. In the northen regions the

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fasies are reflecting a less intensive mobileness of the marine basin bottom and its gradual downwarping during the Visei time. Shallow sea and warm climate all this promoted the wide setting of productides, crinoidea and corals.

The K a l a i m u r a t series

The Kalaimurat series' deposits outcrop in the Central part of the investigated region at the left slopes of the Saidi-Kaion and Kalai-Murat river valleys. They involve an area of I20 sq.km. On the underlying deposits of the Vise or of the Tundarin series the rocks of the Kalaimurat series lie with a washout and with a stratigraphical unconformities. Sometimes in the occurence of the rocks the angular (up to 20°) and the azimuthal (up to $I0^{o}$) unconformities are met.

In the deposits of the Kalaimurat series we did not find any fossils.

The Middle-Upper-Carboniferous age of the considering deposits is established conditionally, mainly for its situation in the section.

The most old rocks which are overlapping the deposits of the Kalai-Murat series in the investigated region are the formations of the Upper Triassic age.

A basal horizon at the basement of the series is not constant in its thickness (I-6 m.). Conglomerates of the basement of the section often contain pebbles of elipsoidal form and boulders (the diameter of which being up to I0 x 30 cm.) from the underlying deposits. The predominant rocks at the lower part of the section of the considered series are greenish-grey and black corrugated thin-bedded phyllites and quartz hydromicaceous schists with subordinated interbeds of sandstones, conglomerates and limestones. At the upper part of the section sandstones of light-grey, grey, rarely of black or brown-grey colour have a noticeble predominance. In the section the rocks are alternating with micaceous aleurolites and containing thin beds of phyllites.

At the up-streams of the Saidi-Kaion river the deposits enclose a sill of dark-green plagioporphyries being 50-60 m. in the thickness, at the exocontact with which the enclosing rocks are noticebly alterated.

The apparent thickness of the Kalaimurat series amounts 2000-2500 m

The degree of regional metamamorphism of the Kalaimurat series' rocks is low. The degree of recrystallization of the rocks is corresponding to the conditions of low temperatures of the green schists facies.

Phyllites and quartz-hydromicaceous schists are composed by sharp-angular fragments of quartz, flaks of sericite or hydromica, kaolinite and leucoxene. Structure of the rocks is pelitic, aleuropelitic, in some plases microlepidoblastic one. Texture is foliated, microbedded or micro-stripped.

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Among sandstones three varieties are singled out:

I. Quartzite sandstones formed by sharp-angular fragments of quartz with the dimentions of 0,3-0,6 mm. and by cementing basal mass, composed by microquartzite. Structure of the rocks is psammitic, granoblastic.

2. Arkose sandstones, composed by fragments of quartz and feldspars, connected by basal cement in the composition of which small fragments of feldspars, quartz, flaks of sericite and partly of clayey minerals come. Structure of the rocks is psammitic, inequigranular.

3. Greywacke sandstones are composed by sharp-angular fragments of quartz, feldspars, siliceous rocks, phyllites with the dimentions of 0,2-0,8 mm. Instead of cement small fragments of the same rocks and minerals are met.

Micaceous aleurolites are composed by grains of quartz, feldspars and flaks of sericite. The initial rocks by which they have originated could serve tufas of quartzy porphyrites. Structure of the rocks is blastoaleurolitic. Texture is foliated.

Conglomerates are composed by rounded pebbles of quartzite and microquartzite with a diameter being I0-I5 up to 20 mm. and by cementing mass in the composition of which come small fragments of jaspers and seggregations of calcite. Structure of the rocks is psephitic, the type of a cement is porous.

Sandy limestones are composed by sharp-angular grains of quartz with the dimentions of 0,2-0,6 mm. and by cementing mass of granular calcite. Structure of the rocks is granular and psammitic.

Plagioporphyrites in the porphyritic seggregations contain crystalls of basic plagioclase with the length of which being I-6 mm. in a considerble degree replaced by sericite and epidote. The ground mass is composed by laths of oligoclase, the length of which being 0,2-0,3mm. In the spaces between grains chlorite, originated apparently as a result of devitrification, and seggregation of epidote and leucoxenized sphene are present. Structure of the rocks is porphyritic, the latter of the groundmass is prizmaticly granular.

For the described deposits of the Kalaimurat series the Middle-Upper-Carboniferous age is adopted by us. It is supposed on the grounds of these rocks occurence with a washout on the rocks of the Visei stage and undoubtedly for it's more low situation as compared to the deposits of the Upper Carboniferous and those of the Low Permian age.

Accumulation of the deposits of the Kalaimurat series took place in shallow sea basin, for all this, the initial stages of sedimentation were characterized by sedimentation of predominantly clayey rocks and the final ones - by sedimentation of sandy rocks. Only from time to time tectonic conditions favoured the accumulation of limestones. Angular and azimuthal unconformities marked in the occurence of the Kalaimurat series on the deposits of Vise stage, testify to the manifestation of tectonic movements during the period which preceded the Kalaimurat transgression.

The F a r k h a r series

Deposits of the Farkhar series are exposed at a small area (40 km^2.) in

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a remote North-Eastern part of the investigated territory. The region of their location are the following: the medium-course of the Namakab river and two slopes of the Farkhar river near the village of Shinhan. The predominant rocks in the section of the series are schists and sand stones,less distributed are aleurolites,extreamely rare met interbeds of limestones.

The section of the Farkhar series deposits in the investigated region is heterogeneous.

In the basin of the Farkhar river the series is composed by frequent interstratification (3-5 m.) of greenish-grey fine-grained micaceous sandstones and dark-grey clayey phyllite-like schists. Rarely in the interstratification dark-grey,lilac argillites are taking part,extreamely rare met thin interbeds of fine-grained limestones.

At the medium course of the Namakab river in the section of the series greenish-grey,dark-grey,rarely violet sandstones are the predominant ones. At some places among these rocks frequent thin interbeds of dark-grey clayey schists,which have a typical penciled jointing are met.

Intensive crumpling of the rocks makes it difficult to determine their thickness.

Orientally it could be valuated as to be 800-I000 m.

According to observation of A.Dezio (I965) the thickness of these deposits in the vicinity of the Farkhar village reaches 2000 m. At the lower part of the section here the series of ~~xx~~ fine-grained quartz-feldspar sandstones with the thickness being I30-I60 m.,contaning beds of quartzy conglomerates is lying. It is overlapped by quartz-sericite schists of black or greenish-black colour.

The basement of the section apparently of the same deposits is exposed near the Kaf Darra village,located at the distance of 6 km. to the South from the Farkhar village. Here according to the data of E.F.Fox (I937) the stratum of black schists with interbeds of black and greenish-black quartzites is underlyed by conglomerates,being I00-200 m in the thickness,which with noticeble angular and azimuthal unconformity are overlapping another stratum of quartzits and schists. The latter apparently belongs to the described above Siyadarin series of the Lower Paleozoic.

The roof of the Farkhar series' deposits form the confirmed by fossils deposits of the upper part of the Upper Carboniferous and Assel sub-stage of the Lower Permian age (see below). The latters by the degree of metamorphism and by their appearence are extreamely alike the deposits of the Farkhar series. However they are overlapping it most

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probably with a washout and with an unconformity. This supposition is confirmed not only by more complicated dislocation of the Farkhar serie deposits in comparison with the dislocation of the Upper-Carboniferous-Lower-Permian rocks,but with a simultaneous occurence of the latter now on the deposits of the Farkhar series(middle-course of the Namakab river),now on the deposits of more old age as well as on the cutting them granits also(basin of the Rudi-Chal river).

Thus the stratigraphical situation of the Farkhar series is determined by its occurence above the Siyadarin series of the Lower Paleozoic (and therefor above the Durumbak series of the Sillurian-Devonian age, connected with the Siyadarin one by concordant transition)as well as by the occurence of it below the undissected deposits of the Upper Carboniferous-Lower Permian age. Most probably it is involving the very upper parts of the Lower Carboniferous,Middle Carboniferous and the most part of the Upper Carboniferous deposits. However,the absence of fossils does not allow to date the age of the Farkhar series more exactly than Carboniferous one.

L O W E R - M I D D L E P A L E O Z O I C,
non-determined more exactly

Outcrops of the Lower-Middle Paleozoic rocks are confined to the core of a large meridional oriented anticline,traced along the valley of the Surkhab river near the town of Pul-i-Khumri. The strip of the Middle-Lower Paleozoic rocks is traced by the right slope of the Surkhab river valley. Then at the distance of 7 km.to the South from the town of Pul-i-Khumry it comes to the left slope and continuing up-stream the river's flow up to the village of Obi-Shur. Separate outcrops of the Lower-Middle Paleozoic rocks are present besides it in the north-western slopes of the Durumbak mountain near the village of Kampirak.

Total area of the Lower-Middle Paleozoic outcrops amounts 30 $km.^2$

The rocks of the Lower-Middle Paleozoic time have no direct contacts with the described above rocks of the Paleozoic and Pre Cambrian age. At their roof with an angular and azimuthal unconformity lay the deposits of the Upper Triassic or Cretaceous time.

Among the undissected deposits of the Lower-Middle Paleozoic age the most widespread are crystalline schists which are by mineralogical composition subdivided into : muscovite-biotitic-quartzy,muscovite-biotite-albite-quartzy (they have a predominant distribution),albite-epidote-biotite-quartzy,epidote-chlorite-albitic,albite-epidote-actinolitic(rarely met),amphibole-quartz-biotite-albitic,albite-biotite-quartzy,almandin-sillimanite-biotite-quartzy (very rarely met)

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In the form of interbeds being 5 rarely I5-20 m. in the thickness at the lower part of the section usually traced amphibolites, micaceous quartzites, and more rarely - marbles. At some places the rocks are injected by quartzy material observed in the form of veinlets being from I cm. up to 0,5 m. in bulges. These veinlets are observed along the schistosity in the rocks. Sometimes they enclose the bodies of alaskite granites.

The rocks of the Lower-Middle Paleozoic age belong to two metamorphic facies - to almandine-amphibolitic one and to the facies of green schists. The rocks belonging to the facies of almandine-amphibolite gravitate towards the Central part of the distribution strip of the Lower-Middle Paleozoic deposits. Less metamorphosed rocks which have underwent recrystallization in the conditions of temperature and pressures of the green schists facies are distributed at its far northern part as well as in the South.

The reasons of irregular spotty character of metamorphism of the rocks of Lower-Middle Paleozoic age are not cleared up finely. It is possible that more intensive metamorphism at the Central part of the Lower-Middle Paleozoic rocks distribution strip is connected with a contact influence of the intrusions of alaskite granites, the greater part of which apparently is not exposed by erosion yet.

Below short petrographical characteristics of the Lower-Middle Paleozoic rocks are given.

Muscovite-biotite-quartzy schists have the following mineralogical composition: quartz, biotite, muscovite, hydrooxides of ferrum, apatite, ore mineral. Structure of the rocks is granolepidoblastic.

Muscovite-biotite-albite-quartzy schists are composed by quartz, albite red-brown biotite, muscovite which are being in an equilibrium association corresponding to quartz-albite-almandine sub-facies of green-schist facies. Nonconsiderable admixture make up apatite, graphite as well as garnet, calcite, ore mineral, sphene.

Albite is often observed in isometric porphyroblasts by wich a fine-platty skapolite is sometimes developed. Structure of the rocks is porphyroblastic, the latter of the ground mass is granolepidoblastic.

Albite-epidote-biotite-quartzy schists are composed by quartz, biotite, epidote as well as by calcite, amphibole and ore minerals. Structure of the rocks is granolepidoblastic.

Epidote-chlorite-albitic schists are composed by albite, chlorite-pennite, epidote, calcite, amphibole, quartz, ore mineral, sphene.

The degree of the rocks recrystallization corresponds to the conditions of quartz-albite-muscovite-chloritic subfacies of green-schists facies. Structure of the rocks is micronematogranoblastic, rarely lepidogranoblastic one.

Albite-epidote-actinolitic schists are composed by equilibrium association of minerals which is stable in the same conditions as the previous one: actinolite, epidote and albite. At some places the crystalls of

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albite are overfilled by intergrowths of actinolite and epidote. Structure of the rocks is fibroblastic, at some places poikiloblastic one.

Amphibole-quartz-biotite-albitic schists are composed by albite, biotite-quartz, blue-green amphibole, calcite, ore minerals, zircone (single grains). In porphyroblastic seggregations columnar crystalls of albite, replaced by calcite could be observed. Texture of the rocks is porphironematogranolepidoblasic.

Albite-almandine-biotite-quartzy schists are composed by quartz, biotite, almandine, albite - characteristic equilibrium association of kyanite-muscovite-quartzy subfacies of almandine-amphibolitic facies. Albite forms rounded untwinned crystalls. Garnet is met in small isometric idiomorphic grains. Texture of the rocks is porphyrogranolepidoblastic.

Almandine-sillimanite-biotite-quartzy schists are characterized by an association of minerals which is stable in the conditions of sillimanite-almandine subfacies of almandine-amphibolitic facies. They are composed by quartz, biotite, sillimanite, almandine. Sillimanite forms separate accumulations of columnar crystalls the length of which being 2-4 mm., almandine-isolated rounded idiomorphic crystalls with a dimentions of I-2 mm. Texture of the rocks is granonematolepidoblastic.

Amphiboles are composed by crystalls (0,4-0,6 mm.) of blue-green hornblende, oligoclase, epidote, ore mineral. Recrystallization of the rocks took place in the conditions of stavrolite-quartzy subfacies of almandine-amphibolitic facies. Texture of the rocks is granonematoblastic.

Micaceous quartzites (quartzitic micaceous sandstones) are composed by grains of quarts and albite, flakes of muscovite and biotite as well as by accessory minerals - apatite, zircone, sphene, tourmaline, ore mineral. Texture of the rocks is granoblastic, inequigranular, at some places - granolepidoblastic.

An apparent thickness of the Lower-Middle Paleozoic deposits in the Pul-i-Khumri region is mesured by an maltitude of I000-I500 meters.

The described deposits are faunistically barren. They have no any lithological similarity with all the described above terrigeneous strata. The degree of their metamorphism allows to consider that the accumulation and recrystallization of the rocks is related to the Pre Visei time. Pre Cambrian age of the rocks is excluded as they are dislocated together with the sills of alaskite granites which cut the Upper-Devonian-Lower-Carboniferous deposits of the Tundarin series. Proceeding from all these idea the described deposits are related by us to the Lower-Middle Paleozoic age.

Quite conditionally for the unclearness of the stratigraphical situation to the undissected formations of the Lower-Middle Paleozoic such deposits as exposed near the village of Kampirak are related also. The section of these deposits has a binomial structure. At its basement the series of greenish-grey slightly-metamorphosed phyllite-like schists is observed. Above the series of light-grey, dark-grey almost black thin-medium-bedded dolomites with interbeds of schists, the thickness of which being nearly I00 meters is lying. At the roof of the section the deposits of Upper Triassic or of Upper Cretaceous time are with unconformity lying

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UPPER DIVISION OF THE CARBONIFEROUS SYSTEM- LOWER DIVISION OF THE PERMIAN SYSTEM

Upper Carboniferous-Lower Permian deposits are the most widespread one in the North-East of the investigated territory-in the basins of the Rudi-Chal and Namakab rivers. In the basin of the Namakab river they were for the first time established by K.Khintse(1964). At the medium-course of the Namakab river these deposits were not studied before.

In the Central part of the region the describing deposits are also for the first time marked at the down-stream of the Wodu river -the left tributary of the Surkhab river. Here they are outcropping in the tectonic blocks and in connection with this they are intensively dislocated. Their section is represented by dense limestones being massive and stratified,often siliceous of black and dark-grey colour,interstratificating with argillites and aleurolites being thinbedded,platy of black colour. Fauna of Tricitites cf.truncatus Chen;Tr.ex gr. pusillus (Schellw),selected from the lower parts of the section was described by E.Ya.Leven as transitional one from the Upper Carboniferous to the Lower Permian one.

Total area occupyed by the describing deposits amounts 50 sq,km.

The Permian-Carboniferous deposits occur with a washout and an unconformity on the metamorphic rocks of the Proterozoic(?) granites and apparently on the subjacent schists of the Farkhar series. In their turn they are with an unconformity overlapped by terrigeneous and effusive formations of the Upper Triasic age.

The described formations are folded.

The most widespread rocks in the section of the Permian-Carboniferous age are clayey slates,limestones,aleurolites,sandstones;in a subordinate quantity gravellites and conglomerates are met. Below a short characteristic of the most often met rocks' varieties is given.

Clayey slates(argillites) have a pelitic clayey,more rarely an ash(? ground mass in which sharpangular fragments of quartz and feldspars are observed.

Limestones are fine- or coarse-grained.They are composed by irregular grains of calcite and by rare sharpangular small grains of quartz.

Sandstones and aleurolites are represented by polimic,quartz-plagioclase and essentialy quartzy varieties. They are composed by fragments of feldspars,quartz,siliceous and volcanogeneous rocks,argillites,ore minerals and chlorite.Fragmental material is of poor and middle roundness. Cement in sandstones is calcitic,siliceous,of predominantly basal type.

The Upper Carboniferous-Lower Permian deposits are represented by uncomplete volume. It is limited by the upper part of the Upper Carboni-

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ferous deposits as well as by Assel stage (the lower part of the Sakmar stage) of the Lower Permian deposits. Their age is established on the grounds of numerous finds of brachiopoda and fusulinides, studied by E.Ya.Leven and by T.A.Grunt.

Two reference sections drawn up at the right slope of the Rudi-Chal (Banhi) river valley and in the medium-course of the Namakab river allowed to quite in detail study the stratigraphical sequence of the Upper Carboniferous-Lower Permian deposits. Here the following rocks are exposed (see fig.8 dr.I5):

I. Sandstones of violet-grey, rarely of greenish-grey colour, polimic ones with frequent interbeds of gravellites and fine-pebbly conglomerates..... 2I m.

2. Aleurolites of greenish-grey colour, medium-bedded..... I00 m.

3. Poorly exposed section of the slope, composed by violet-grey sandstones and aleurolites with separate interbeds of gravellites..... I5 m.

4. Interstratification of limestones of violet-grey, greenish-grey colour, being lumpy and argillites of dark-grey, violet colour, fine-fragmental ones..... 22 m.

5. Alternation of aleurolites of greenish-grey colour, being lumpy (the predominant ones) and argillites of dark-grey colour.. I2 m.

6. Aleurolites of greenish-grey colour, being medium-bedded I2-I4 m.

7. Interstratification of limestones and argillites..... 22 m.

8. Aleurolites of greenish-grey colour being thin-up to medium-bedded.

At the lower part of the bench interbeds of gravellites (5-I0cm.), rarely of fine-pebbley conglomerates are quite often met; at the upper part of the section - separate lumps or thin interbeds of limestones. In limestones in abundunce met[x]: Quasifusulina ct.paracompacta chang, Rugofusulina complicata(Schellw), Parashhwagerina sp.nov., Pseudofusulina sp.nov. At the left slope of the Bangi river valley in these deposits besides the mentioned above fauna the following is met: Pseudofusulina ferganensis (Dut), ct.confinii Kahl.et Kahl., Ps.ct uralica Krot., Quasifusulina paracompacta Chang, Rugosofusulina sp. ..... 40-45 m.

9. Aleurolites greenish-grey with thin interbeds of limestones and argillites of dark-grey or greenish-grey colour. At some places these rocks being in often alternation. The interbeds of limestones contain Pseudofusulina sulcata Korzh., subsp.nov., Quasifusulina aff.caycuxi(Depr), Q.paracompacta Chang, Rugosofusulina ct.complicata(Schellw) Robusto schwagerina ct.micleolata(Ciry) Paraschwagerina sp.nov....I0 m.

I0. Stratum of limestones of dark-grey colour, thinbedded.....I m.

II. Sandstones and aleurolites of violet, greenish-grey colour with interbeds of fine-fragmental argillites(up to 2,5 m.)..... 25 m.

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x) Determination of fossils is carried out by E.Ya.Leven.

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I2. Argillites of dark-grey colour with lumps or interbeds of limestones (2-8,rarely up to I5-20 cm.).At the upper part of the section in the interbeds of limestones Quasifusulina aff.cayeuxi (Depr),Rugosofusulina complicata (Schellw),R.spendida Bensh,Paraschwagerina sp.nov. are met..... I5 m.

I3. Sandstones greenish-grey fine-grained lumpy,often thinbedded. At the upper part of the section among the sandstones the interbeds of limestones,containing remains of Schwagerina(?) ex gr. minuta Chang,Eoparafusulina sp. are met. At the roof of the bench a bed of limestones with Paraschwagerina ex gr.pseudomiza M.-Mael., Eoparafusulina sp.,Pseudofusulina sp.,Quasifusulina sp. is lying ... . 45 m.

I4. Interstratification of aleurolits (the predominant ones) and sandstones of violet,greenish-grey colour.....60 m.

I5. Sandstones violet,greenish-grey thick-bedded with interbeds (3-5 m.) of aleurolites of greenish-grey colour ..... nearly 50 m.

I6. Frequent interstratification of aleurolites and limestones. At the lower part of the section the limestones contain: Paraschwagerina pseudomira M.-Macl.,Pseudofusulina parasolida Bensh, Quasifusulina paracompacta Chang,Q.ct.cayexi(Depr),Paraschwagerina ex gr. pseudomiza M.-Macl.,Pseudofusulina uralica (Krot.)subsp.nov., Quasifusulina sp.....I2-I5 m.

I7.Sandstones of violet colour polimic with thin interbeds of aleurolites and argillites..... I7 m.

I8. Sandstones of greenish-grey colour,arkose ones..... I2 m.

I9. Frequent alternation of aleurolites,argillites and limestones Interbeds of limestones at the lower part of the section contain: Paraschwagerina inflanta Chang,Pseudofusulina parasolida Bensh,Quasifusulina aff parscompacta Chang. Interbeds of limestones at the upper part of the section are overfilled by : Paraschwagerina inflanta Chang,Pseudoschwagerina robusta (MEEK),Pseudofusulina parasolida Bensh,Ps.ct. fergananensis (Dut.),Quasifusulina aff. cayeuxi(Depr.), Regosofusulina complicata (Schellw.), Triticites shengi (Chang). At last in the interbeds of limestones of the upper part of the section the following fossils are discovered:Pseudofusulina ex gr.parasolida Bensh,Rugofusulina complicata (Schellw.),Triticites shegni(Chang),Quasifusulina sp.....I5 m.

20. Sandstones of violet and greenish-grey colour arkose ones and polimic,containing a considerable admixture of volcanogeneous material..3,5m

In the north of the region the unconformably lying effusive formation of the Upper Triassic age are exposed. Total thickness of the described above deposits amounts to I5-425 meters. According to the conclusi-

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on of E.Ya.Leven they belong to the Sakmar stage of the Lower Permian age or to be more exact - to its lower part, singled out in the Urals as independent Assel stage, corresponding to the Schwagerin horizon.

In the basin of the Namakab river the section is formed by the same rocks that is by aleurolites, clayey slates, limestones, sandstones. However the colour of the rocks here is less motley. Bright violet-green tints here leave the place for moderate ones - to grey, dark-grey, greenish-grey. The role of sandstones in the section is clearly decreased, while the role of limestones is encreased.

The pointed out above is obviously illustrating the section, which was described at the medium-course of the Namakab river (fig.8, dr.I6). At the basement of the section (direct contact is turfed) here the stratum of sandstones and cleyey schists of the Farkhar series is lying. Above the following section (from the bottom) is traced:

I. Limestones grey, dark-grey, thin-medium-laminated with interbeds of schists of dark-grey colour, being clayey and rarely interbeds of aleurolites of greenish-grey colour. In the limestones small shells of Triticites articus (Schellw), Quasifusulina (?) sp. are met which probably belong to the Upper Carboniferous, the thickness is nearly .....80 m.

2. An intrusive sheet, composed by dark-green albitizated diabases and amphibole porphyrites ..... nearly 50 m.

3. Interstratification of aleurolites of greenish-grey colour and clayey slates of dark-grey colour. Among the interstratificating rocks sometimes the interbeds of dark-grey limestones with Paraschwagerina pseudomiza M.-Macl., Quasifusulina ct.paracompacta Chang could be met, which are characteristic for the Assel stage of the Lower Permian age, the thickness being not less than ..... 300 m.

4. Aleurolites of greenish-grey colour with numerous (at the upper part of the section) shells of brachiopodae: Chorisites fritschi (Schelluren), Neospirifer ex gr, fasciger Tscheru, the thickness being ..20-30 m

5. Limestones grey medium-grained including shells of: Paraschwagerina ex gr. pseudomiza M.-Macl., Pseudofusulina subcata Korzh.subsp.nov. Quasifusulina paracompacta Chang., which determine the Assel stage of the enclosing deposits, the thickness being .....I0-I5 m.

6. Slates of grey and dark-grey colour fine-fragmental with often interbeds of aleurolites being of greenish-grey colour as well as limestones being grey and fine-grained. In the limestones remains of fusulinidae of the Assel stage are found, they are: Paraschwagerina tinvenking (Lee) subsp.nov., Quasifusulina paracompacta Chang, Robustoschwagerina

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geyeri(Kahl.et Kahl.), Rugosofusulina complicata(Schellw)as well as brachiopoda Dictyoclostus sp.,the thickness being nearly ..... 60 m.

7. Limestones black,dark-grey,thin-medium-laminated aphanitic,rarely -finegrained,at the basement of the series being clayey with abundant shells of Assel fusulinidae: Paraschwagerina tinvenkiangi(Lee) subsp.nov Pseudofusulina uralica (Krot.)subsp.nov.,Ps.ex sulcata Korzh.,Quasifusulina paracompacta Chang,Robustoschwagerina aff.geyeri (Kahl.et.Kahl), Eoparafusulina(?) sp.,Boultonia sp.,the thickness being .....80-I00 m.

8. Sandstones greenish-grey polimic ones with interbeds of conglomerates being fine-pebbly and interbeds of slates being of grey colour and which have a pencil jointing. At the upper part of the bench interbeds of limestones containing shells of : Pseudoschwagerina beedi (Dunb. et Sk.) subsp.nov.,Boultonia sp.,Quasifusulina sp.,Rugosofusulina sp., Robustoschw,also of the Assel stage are met,the thickness being nearly ....80-90 m.

9. Intrusion sheet of green or grey granites-porphyries,the thickness being not less than ..... I00 m.

Then runs a fracture at the southern wing of which limestones of Sillurian-Devonian age are lying. Total thickness of the described sedimentary rocks amounts 630-675 meters.

The strip of the described deposits is continuously traced to the upper-stream of the Shatu sai(left tributary of the Namakab river). Here among the greenish-grey aleurolites and argillites several horizons of limestones,in which brachiopodae and fusulines are met, are lying.

Among the brachiopodae side by side with the forms typical for the basement of the Permian age (the Assel stage,Schwagerin beds)- that is Derbyia ct. grandis Waagen, Dictioclostus ex gr.bolurensis d'Orbingny, Cancrinella cancriniformis Tschern.,Phricodothyris rostrata(Kutorga), such forms as being characteristic for the upper part of the Upper Carboniferous deposits,that is: Dictyoclostus bathycolpus (Schelluren),Neospirifer tegulatus Trautsched could be met.

Among fusulinida exclusively Assel forms could be met: Paraschwagerina ex gr. pseudomiza M.-Macl.,Pseudofusulina sulcata Korzh. subsp. nov.,Pseudofusulina fecunda Sham.et Scherb., Ps. ferganensis (Dut), Quasifusulina parocompacta Chang, Rugofusulina complicata(Schellw), Robustoschwagerina nucleolata (Ciry), R. geyeri (Kahl.et Kahl.),Eoparafusulina sp.,Quasifusulina sp. They are found in the horizones of limestones,situated apparently above the horizons with brachippodae.

* * *

On the grounds of the stated above material the Upper Carboniferous-Lower Permian deposits of the Chal-Namakab region are subdivided by

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us into two series: the lower one being of grey colour which is most completely represented at the medium course of the Namakab river, and the upper one being of motley colour, outcropping at the right slope of the Rudi-Chal(Banghi) valley. These two series are not only clearly differ for their colour and character of the composing rocks' interstratification, but they contain somewhat different complexes of fusulinidae. The complex of fusulinidae, discovered at the lower part of the grey-coloured series' section is represented by the following forms: Triticites arcticus(Schellw.), Triticites sp.nov., Quasifusulina(?) sp. This complex according to the determination made by E.Ya.Leven is characteristic apparently for the Upper Carboniferous age.

Approximately at the same stratigraphical level in the deposits of the grey-coloured series brachiopodae are met. The part of them is characteristic for the upper horizons of the Upper Carboniferous, the second part is typical for the Permian age. T.A.Grunt determined here the following species: Dictiloclostus bahtycolpus(Schelluren), which is characteristic for the upper part of the Upper Carboniferous; they are distributed in the Upper Carboniferous deposits at the Kara-Chatyr ridge; Debbyia ct.graudis Waagen Phricodothyris rostrata (Kutorga), Dictioclostus ex gr.bolurensis d'Orbigny, Cancrinella concriniformis Tschern, are met in the Schwagerin horizon of the Lower Permian(Solyanoi ridge, Southern Urals).

Complex of fusulinidae which is met in the above lying deposits belongs to the Sakmar stage of the Lower Permian, or to be more exact - to its lower part- the Assel stage, corresponding to the Schwagerin horizon. This complex of fossils is innumerated above.

To the belonging of the deposits to the Lower Permian age also testify brachiopodae, which are met at the medium part of the grey-coloured series. Among them Neospirifer ex gr.fasciger Tschern is the form being characteristic both for the Upper Carboniferous as well as to the Lower Permian ages. As for Choristites fritschi(Schelluren) it has less wide distribution and is met at the upper part of the Upper Carboniferous and of the Lower Permian age only, being in the Southern Fergana the typical for the base of the Lower Permian(Schwagerin horizon). Shells of Dictyoclostus sp. have poor preservation, their age could not be determined more precisely than the Carboniferous-Permian.

Among the deposits of the motley-coloured series fusulinae characteristic exclusively to the Assel stage of the Lower Permian(enumerated above) are met.

In the valley of the Rudi-Chal river(Banghi) the Lower Permian depo

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sites were ascertained by K.Khintse(I964). Among fusulinae collected by him at the eastern bank of the Banghi river near the Chashma Gavan the following forms had been determined: Schwagerina cf.linearis Dunbar et Skinner,S.ct.furoni Thompson,Schwagerina sp.,Pseudoschwagerina sp.The joint find of Pseudoschwagerina,Paraschwagerina allowed to relate these deposits to the lower parts of the Lower Permian age,that is to the Sakmar stage. Brachiopodae,discovered in sandstones and in slates both at the Chashma Gavan as well as at the Badam Darra to the North-East from the Samandao village had been investigated by K.Khintse who determined the following forms: Spirifer neostriatus Fredericks, S.Wynnei Waagen, Reticularia cf lineata(Martin),Dictyoclostus semireticulatus(Martin), Derbya grandis Waagen, Chonetes sp.,Bellerophon sp.

These species widely known among the Permian deposits of India, Pakistan and other places and they allow to relate the enclosing them deposits to the same age.

Most part of the fossils or even the whole collection of K.Khintse is related to the partycoloured series.

The stratigraphical section of the Upper Carboniferous-Lower Permian deposits of the Chal-Namakab region is supposed to be continuous,without erosional breaks. The more high stratigraphical situation of the partycoloured series as compare to the grey-coloured one is proved not only by the direct occurrence of the partycoloured deposits on the grey-coloured ones(the up-stream of the Rudi-Zamburak river) but by the presence of the latter fossils of the Lower Carboniferous age at the basement of the section as well.

Total thickness of the Upper Carboniferous-Lower Permian deposits of the Chal-Namakab region,calculated by the mentioned above the most complete sections amounts I045-II00 meters.

In the Central Hinukush,between the Shibar pass and the village of Buloa as well as near the village of Bamian the so called "series of fusuline limestones" is known. G.GAiden(I9II) related it to the Upper Carboniferous and Permian age. In I964 Thompson carried out the revision of G.Gaiden's determinations and ascertained that Fusulina elongata of G.Gaiden in reality was Polydiexodina,Schwagerina princeps+ Verbeekina and Sumatrina annae=Afghanella Schencki. On this ground Thompson related the "series of fusuline limestones" of G.Gaiden to the Upper Permian.

According to our request the determinations of G.Gaiden had been analysed by E.Ya. Leven also. He confirmed that all the species enumerated in the list of G.Gaiden and reflected in the ta bles are typical for Murhab stage of the Upper Permian age; as for Schwagerina princeps and

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Fusulina uralica - the guide forms for the Schwagerin seams of the Urals with the help of which G.Gaiden based the dating of the age for the lower horizons of the fusuline limestones series' section, in the determination was a mistake. The first form is a typical Verbeekina, the second one is quite analogical to Parafusulina gigantea (Depr.)- the form which in Japan and in the northern Pamirs is typical for the lower part of the Upper Permian age.

The analysis of fusulinidae has shown that the Upper Permian complex of fusulinidae of the series of fusulinid limestones of the Central Hindukush is typical for the region of Tetis, while Sakmar complex of the left bank area of the Surkhab river as well as of the Chal-Namakab region is more clearly gravitating to the Urals and is very close to the complex from the Permian deposits of the Soviet and Chineese Tien Shan.

P E R M I A N S Y S T E M

Within the limits of the investigated territory the Permian system is represented by the part of the Lower division only, crowning the section of the Paleozoic formations.

The Lower Permian age has already the upper part of the described above subdivision(undissected deposits of the Upper Carboniferous -of the Lower Permian age). Besides it the deposits of the Sakmar and Sakmar and Artin stages (undissected ones) are singled out by us.

The Lower Permian rocks on the described territory have been described for the first time. Before the Lower Permian deposits were marked beyond the limits of the area in the region of Bamian by G.Gaiden(I9I3) and by R.Furon. Under the denomination of " fusuline limestones" which was given to them by G.Gaiden they are mentioned by another investigators as well: Thompson M.(I964), Popol S. and Tromp S.(I954).

The Lower Permian terrigeneous-calcareous deposits involve a non-considerable part of the covered by mapping territory- approximately 60km^2. Separate their outcrops are traced by the left bort of the Surkhab river from the mouth of the Amir-Omad river up to the mouth of the Saidi-Kaion river.

The age of the considering below subdivisions is confirmed paleontalogically.

Spatially the describing below formations are confined to a large rupture structure, elongated in the North-Eastern direction by the left bank of the Surkhab river. In connection with this the rocks are intensively dislocated, their strike in the most number of cases corresponds to the direction of this zone.

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The most widespread rocks in the section of the Lower division of the Permian system are argillites, slates and phyllite-like schists, aleurolites, sandstones and limestones. Gravellites and conglomerates are rarely met.

Limestones are grey, dark-grey, sometimes black with massive and laminated texture. They are fine-and medium-crystalline rocks often containing a considerable amount of organic remains and providing a smell of sulphide hydrogene when striked. Sandy and clayey varieties are also met which make gradual transitions to sandstones and argillites.

Argillites are black, dark-grey, greenish-grey, rarely red-violet, thin bedded rocks, composed by sericite, hydromicae, cryptocrystalline quartz and some quantity of calcite.

Aleurolites by their texture and colour do not vary argillites. The aleurolitic material (it makes from 50 up to 80% of the rock) is represented by angular grains of quartz and feldspars. Their size does not exceed 0,07 mm. The sandy material (mainly quartz in the form of semirounded graines with the dimentions up to 0,3 mm.) is present in the amount of up to 10%. The cement of aleurolites is clayey with little admixture of carbonate matter.

Sandstones - the rocks of black, dark-grey, grey, greenish-grey and brow colour, which have more thick-bedded than aleurolites texture. The fragmental material of the sandstones is quartz-feldspatic, well rounded and sorted. The size of the grains does not exceed I mm. Cement is clayey, with admixture of carbonate matter.

Gravellites - grey, brown-grey, sometimes greenish-grey, thick-laminated rocks, containing a well rounded pebble of quartz, schists, effusives the size of which being up to I,5 cm. Fragmental material is poorly sorted and the rock is containing approximately equal quantities of sandy and gravelly graines. Cement of the gravellites is clayey or carbonaceous-clayey.

Conglomerates have grey, brown-grey or green colour. Well rounded pebble is represented by quartz, effusives, phyllites, limestones; granites and sandstones are rarely met. The size of pebbles does not exceed I0 cm usually it is 2-4 cm. Cement of the rocks is clayey, with little admixture of carbonaceous matter and chlorite. Conglomerates, composed by pebble of grey fine-crystalline limestones, cemented by carbonaceous material, are also met.

The considering deposits with washout and unconformity lie on the metamorphic schists, as well as on effusive and terrigeneous deposits of the Lower and Middle Paleozoic and in their turn are overlapped by the rocks of the Upper Triassic age.

The S A K M A R stage

The rocks related by us to the Sakmar stage are outcropping in the form of several separated outcrops at the lower parts of the Saidi-Kaion and of the Amir-Omad rivers' streams (fig.8, dr. I3). Total area occupyed by them does not exceed 20 km^2.

The most complete their section could be observed at the mouth of the Saidi-Kaion river as well as at the interstream area of this river with the river of Surkhab (fig.I7). On the metamorphic schists of the

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Tundarin series with angular and stratigraphical unconformities(from bottom to the roof)the following rocks are lying:

I. Conglomerates of grey colour,medium pebbly calcareous..... 3 m.
2. Slates of violet-red colour..... 6 m.
3. Conglomerates medium pebbly calcareous,transiting at the upper part of the section into clayey limestones..... 5 m.
4. Schists of violet-red colour,at the upper part - of greenish-grey colour with interbed of limestones of yellowish-grey colour,clayey ones (I m.)..... 9 m.
5. Conglomerates fine-medium pebbly with interbeds of grey limestones..... 20 m.
6. Limestones of light-grey colur with abundant remains of Sakmar fusulinidae*).Dervasites.ex gr. ordinatus(Chen), Pseudofusulina chamchitensis(Colani),Quasifusulina longissima(Moeller), Rugosofusulina ex gr.latioralis Raus. R.ex gr.alpina(Schellw.), Minojapannela sp.,Triticites sp..... ..... 200 m.
7. Slates of light-grey colour with greenish tint with frequent interbeds of limestones(),I-I,2 m.) of black colour,platty150 m.
8. Limestones grey,dark-grey;at the lower part are characterized by poorly preserved remains of Pseudofusulina sp.,Schubertella sp.,Triticites sp.,at the upper part they contain shells of Zellia amedai(D (Depart.),Pseudofusulina(?) sp.,Triticites sp.,which are met among the deposits of the Sakmar stage.....nearly 400 m.
9. Intrestratification of sandstones of brown-grey colour,argillites and aleurolites of dark-grey,black colour with interbeds of sandy limestones(up to 5 m.).At the foot of the series sandstones and gravellites are the predominant..... ..... 400 m.
I0. Limestones grey,dark-grey,thinbedded,crinoidal..... Ioo m.
II. Further above the section is limited by a fracture.

Total thickness of the deposits in the described section amounts I293 m.

The S a k m a r and A r t i n stages undissected ones.

The Sakmar-Artin undissected formations are met at the interfluve area of Janhak-Pili (the left tributaries of the Surkhab river,falling into it I8 km. off up-stream the village of Doshi,fig.I8,dr.I4). A single outcrop of these deposits has an area of nearly 4 sq.km. The deposits under consideration lie unconformably on the metamorphic schists of the

*) Here and below the fossils are deternined by E.Ya.Leven

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Siyadarin series and being overlapped by granites of the Upper Triassic -Lower Jurassic age;their relations with the deposits of the Sakmar stage remain unclear for the lack of direct contacts.

Small scale of the outcrop,disconnections with the Upper-and Lower lying rocks,strong dislocation of them did not allow to determine a true thickness as well as a regularity of the Sakmar-Artin deposits' structure.

As a main the stratum is composed by argillites,aleurolites,sandstones of grey,brown-grey colour. Among them separate lens-like interbeds of black platty limestones are met. Among these limestones,situated at the lower parts of the section the following fauna had been discovered: Darvasites contractus(Schellw. et Dyhr.),Rugosofusulina ex gr. stabilis, Raus.,Nankinella sp.,Pseudofusulina sp.,Schubertella sp.According to the determination made by E.Ya.Leven,who studied the collection,the age of these deposits is a transitional one from the Upper parts of the Sakmar to the Lower parts of the Artin stages.

Total apparent thickness of the stratum is approximately amounts I000 meters.

The Lower Permian time was characterized by a comparatively stable tectonic regime within the limits of the investigated area. At its boundary with the Upper Carboniferous epoch a transgression of a sea basin lead to the formation of coarse-fragmental and later with the deepening of the basin-to the formation of terrigeneous-carbonate strata. The beginning of this process at different areas of the region apparently did not coinside in time as the accumulation of the deposits in some regions began only with the end of the Sakmar-beginning of the Artin ages. The regime of shallow and warm sea was preserved within the limits of the region under consideration during the whole Lower Permian time.

T R I A S S I C S Y S T E M

The Triassic deposits within the limits of the Northern Afghanistan were marked by different investigators. Among them first of all the following should be mentioned: K.G.Grissbakh(I886),G.G.Gaiden(I9II),R.Furon (I925,I94I), B.A.Petrushevski(I94I),R.Furon and L.Rosse(I954),S.Popol and S.Tromp(I954),S.Tromp(I954),D.Veippert(I964),V.I.Bratash,V.V.Pechnikov, Ju.S.Shakhijanov(I96I),G.N.Khatiskatsi,A.K.Dertev, Ju.V.Pashkov(I963) and others.

Within the limits of the territory interesting to us these investigators touched upon a very limited number of places to which first of all should be related the regions of the Doabi-Mekhzarin,Pul-i-Khumri,Kampirak

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villages, the pass of Chal and some others.

Our investigations allow to successively and systematically trace the character and distribution of a facial alternation of terrigeneous deposits of the Triassic age on a comparatively vast territory. It is known that in connection with this the more detailed dissection of the Triassic deposits had become necessary. The previous denomination of the "Doab series" at the present time could have a significance only in a sense of G.Gaiden, that is conformably to the Upper Triassic deposits in general. The same should be said about "the Lower" and " Upper " seies of Doab (S.Tromp). In the cases when the age more or less exactly dated, we tried to use the generally established international stratigraphical subdivisions and only in the cases of completely unknown age we came to the singling out of series according to lithological and other features.

The deposits of the Triassic system within the limits of the investigated territory are exposed on a comparetively limited area, involving nearly 620 sq.km. or 4,8% of the whole investigated territory. They are exposed in the form of separate areas, elomgated as in the main in the North-Eastern direction, following in subparallel position the outcrps of Paleozoic rocks, which limitating the investigated territory from the South-East. To the North-West and to the North the Triassic deposits are qiukly hidening under the overlapping them more yong deposits; in separate tectonic blocks they are either limited by systems of dislocations with a break of continuity, or fall out from the section in conscequence of Pre Cretaceous erosion manifestation. In the West small by the area outcrops of the Triassic deposits are exposed in erosional-tectonic windows from under the deposits of the Jurassic and directly of the Cretaceous ages.

The most significant by the area outcrpps of the Triassic deposits are observed in the Central part of the investigated territory, at near-interfluved spaces of the Ishpushta, Ferozak, Chukidara and Akhengaran ririers(mountains of Kukhi-Jaukar, Kukhi-Ishpushta, Kukhi-Bechezam, etc.) as well as at the up-streams of the Saidi-Kaion, Turmush, Akhegaran and Sargal rivers (mountains of Bandi-Shaudan, Vuch Margau, Sangi Abulgashti etc.), also along the left bank and partly along the right bank of the Surkhab river at the area between the Saihan and Saidi-Kaion rivers and in the region of the Kampirak pass. In the mentioned above regions the most complete sections are known.

Further in the direction to the North-East the deposits of the Triassic age had been ascertained in the basins of the right upper tributaries of the Arhandab river, partly running out by their up-streams into the investigated territory in the region of the Nakhrin village as well as in

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the far North-East of the investigated territory at the interfluve areas of the Chal,Zamburak,Namakab and Furkhur rivers.

The outcrops of the Triassic deposits had been also ascertained in erosional-tectonic windows in the basins of the Shabashek and Alma rivers(in the region of the Sary-Assiya village),at the up-streams of the Toga-Shamar river,at the left tributaries of the Kaftarkhan river,in the region of the Doab village(Tatar),in the region of the Kara-Kotal as well as at a number of another places.

Broken distribution of the Triassic deposits in the investigated region is explained not only by the overlapping of theses deposits by more yong deposits,but by the initial irregular their distribution as well. Besides it,the Pre Jurassic tectonic movements and accompanying them erosional-denudational processes had lead to the partial or complete their destruction on vast spaces.

As a main the Triassic deposits are represented by a very thick stratum (over 7500 m.) of different volcanogeneous and terrigeneous-sedimentary rocks,usually not forming continuous unbroken sections. The latter circumstance is explained by the peculiarities of the tectonic regime and of the sedimentation during the Triassic period of time,about what it will be noted below.

The whole stratum of the Triassic system's deposits by a first approximation could be subdivided into three large lithologically different and different by age complexes.

The lower one-uniting the deposits of the Middle division- is represented by volcanogeneous formations as a main: by lavae of acid and basic compositions and by their pyroclasts with rare thin benches of terrigeneous-sedimentary rocks with marine fauna. These deposits inspite of their great thickness have a limited distribution.

The middle one-involving the deposits of the Karnii and Norii stages-is represented by argillites,aleurolites,greywacke sandstones,rarely by coarse sandstones ,the total thickness of these deposits amounts II00-I500m. These deposits also contain marine fauna. They have the most wide aeral distribution.

The upper one- by the age corresponding to the Ret stage. The deposits of this complex,as well as those of the lower one in considerable degree are represented by volcanogeneous rocks: aglomerate lavae,welded tuffs, lavabreccias and rarely by lavae of acid and basic composition with benches of terrigeneous-sedimentary rocks of continental origin and with the remains of Ret flora. The thickness of these deposits reaches I800 meters. On some areas the volcanogeneous formations partily or completely replaced by terrigeneous-sedimentary formations.

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The lower and upper complexes of the deposits according to their litholo gical features are subdivided into series and parts of series.

The dissection of the Triassic system's deposits in the investigated region appears as follows below:

Upper division	The Ret stage	The Turmush series The Ishpushtin series	The Pul-i-Khumri series	The Cheldukhtaran series c) " upper part" b) " middle part" a) " lower part"
	The Norii stage (is mapping together) The Kornii stage			
Middle division	The Shukradarin series The Irmalik series			?

The deposits of the lower division in the investigated regiom were not ascertained.

Below the successive description of the singled out stratigraphical subdivisions is given.

The Middle division

The deposits of the Middle division had been ascertained mainly in the Central part of the investigated region in the form of closed one to another three outcrops with the total area being 2I0 sq.km. The outcrops have an isometric,somewhat elongated in the East-North-Eastern direction confuguration with the total extent being 46-47 km.,the width of it being 25-26 km.

The last rear outcrop of the Triassic deposits is observed in the region of the Kara-Kotal pass and in the adjacent to it valleys:from the South(up-streams of the Madr river,and from the North(the Charmak-Sai, eastern river). It is limited mainly by more yong rocks being from the Upper Triassic up to the Upper Cretaceous age which are transgressively overlapping the deposits under description as well as partly by dislocations with a break of continuity.

The second more considerable by its area outcrop is located to the East from the firs one - at the up-streams of the Ishpushta,Ferozak and Chukidara rivers,involving the interstream area ridge between these rivers and the river's valley of Akhengaran,named here as Kukhi-Jaukar. From the West and partly from the North it is limited by transgressively overlapping Upper Cretaceous and in less degree - by Neogene deposits; from the East-it is limited by an intrusive complex with granites and diorites of the Surkhob intrusion,from the South-by a tectonic contact

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with the Upper Cretaceous,Cretaceous,Paleocene,Paleocene and Neogene deposits.

The third exposure is located to the North-East from the first two,at the up-streams of the Turmush and Akhengaten rivers,involving the mountains of Wuch Margau and others. The outcrop from the North,North-West and from the West is limited by tectonic lines;from the South the distribution of the Middle Triassic deposits is limited by an intrusive contact with the granites of the Sukhob intrusion.

Besides the mentioned outcrops the non-considerable by area outcrops had been ascertained in the direct vicinity from them in the valley of the Sargala (up-streams) river,at the mountains of the Kukhi-Takhte Ch. Chingiz. The latter is the far northern outcrop of the Middle Triassic deposits in the investigated region.

The Middle Triassic deposits at another places of the investigated territory were nowhere met.

The Middle Triassic deposits are represented by volcanogeneous formations of acid and basic composition mainly,among which lavae,lavabrecciae,aglomerate lavae, welded tuffs,tuffs are marked. Sedimentary deposits are episodically met and being in subordinate quantity. They are represented by sandstones,aleurolites,often calcareous ones with marine fauna and vegitational detritus.

Superimposition of the Middle Triassic deposits on the more old ro rocks within the limits of the investigated territory was nowhere met, In a number of places they are transgressively overlapped by the deposits of the Upper Triassic and more often - directly by the deposits of the Upper Cretaceous age.

On the grounds of the difference in the lithological composition the deposits of the Middle Triassic age are divided by us into two series (from above): the Irmalin and the Shukradarin ones. Below their description is given.

The I r m a l i n series

The deposits of the Irmalin series are exposed on the area of not more than I50 sq.km. Their outcrops were ascertained in the region of the Kara-Kotal pass by the right bank of the Charmak-Sai (eastern) river,as well as at the up-streams of the Ishpushta,Ferozak and Chukidara rivers, also at the interstream area of them with the Akhengaran river,in the mountains of Kukhi-Jaukar.

The foots of the Irmalin series inspite of its very considerable exposed thickness within the limits of the investigated territory were not met. They are concordantly overlapped by the deposits of the above-

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lying Shukradarin series. To the South from the pass of Kara-Kotal the deposits of the Irmalin series are with unconformity overlapped by the deposits of the Karnii-Norii stages of the Upper Triassic,or by the deposits of the Upper Cretaceous age. From the East the distribution of the Irmalin series deposits is limited by an intrusive contact running with the granites of the Surkhob intrusion.

The Irmalin series is composed by the monotonous stratum of dark, greenish-black andesitic porphyrites,plagioporphyrites,welded tuffs and rarely tuffs of the same composition. Here rare interbeds of felsitic porphyries are also could be met.

Andesitic porphyrites - the rocks of dark-green,greenish-black, grey-green,lilac-black colours with massive texture. Structure of these rocks is porphyritic,the latter of the ground mass is microlitic,pilotaxitic,gialopilitic. In the impregnations-augite,common hornblende,plagioclase (No.50-55,rarely up to No.70). The size of impregnations is up to 5 mm. The ground mass (up to 90% of the rock) is composed by small laths and microlites of plagioclase(usually of No.No.40-45),not completely crystallized glass of greenis or greenish-brown colour,augite and rarely amphibole. The size of the ground mass grains usually does not exceed 0,08 mm. Secondary alterations are expressed by neogenetics of chlorite, epidote,actinolite,carbonate,sometimes of sericite;in the form of fine impregnation ore mineral by which hydrooxides of ferrum or leucoxene are developed is often present.

Tuffs of andesitic porphyrites have a green,dark-green,rarely lilac green colour. Texture of the rocks is massive,rarely unclearly-bedded, structure is psammitic,pssammito-aleuritic vitrolitocrystalloclastic. Pyroclastic material is composed by angular and semi-angular fragments of plagioclase,andesitic porphyrites,rarely of chloritizared,carbonatizated glassy material being of brown colour. The size of fragments is up to 2,5 mm.;cement is usually of basal type and is composed by microcrystalline glassy material,ash,chlorite and hydrooxides of ferrum.

Welded tuffs and agglomeration lavae of basic composition differ one from another by the sixe of the fragments only. Their colour is greyish-green,dark-green,lilac-green. Texture is massive,rarely unclearly-bedded The ground mass of the rocks is composed by glassy substunce of green, greenish-brown colour,in which fragments of andssitic porphyrites are enclosed as well as fragments of volcanogeneous glass the size of which being from parts up to 50 cm.

Tuffs compound (for the acidity) are coloured in green with grey tint colour. Texture of the rocks is massive,structure is psammitic,rarely - psammito-aleuritic and psephitic,vitrolitocrystalloclastic. The sharpangular fragments (40%) are represented by plagioclase(oligoclase-andesine),quartz,common hornblende(sometimes up to 20%);among the fragments of the rocks the following varieties are distinguished: porphyries microgranites,quartzy porphyries,episodites,amphybolic andesitic porphyrites,felsitic porphyrites,rarely chloritizated volcanic glass. The size of the fragments is up to 3 mm. The connecting mass is basal,it has a tuff structure and is composed by cryptocrystalline glass and volcanic ash. Secondary minerals are the following: epidote,chlorite,sericite, hydrooxides of ferrum.

Plagioporphyrites have dark-green and green colour. Their texture is massive,structure is porphyritic with pilotaxitic and trachytic ground mass. In rare porphyritic seggregations- basic plagioclase(No.No.4045) with the size of grains being 0,5-I,0 mm. The ground mass is composed by

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small laths of acid and basic plagioclase,

Tuffs of plagioporphyries in outward appearnce do not differ from the described above tuffs of andesitic porphyrites. The composition of pyroclasts is different only: instead of andesitic porphyrites there are plagioporphyries;plagioclase is represented by oligoclase.

The drawing up of a detailed section of the Irmalin series offers a considerable difficulty for a complicated tectonic environment as well as for a poor exposure. It should be noted however that at the upper parts of the section plagoporphyries and their tuffs are apparently more often met than at the lower parts of the section,where andesitic porphyrites and their pyroclastic equivalents are the predominant.

In the section as a main the most widespread are lavae which form thick (up to I00-I80m.) of massive structure covers,divided by less thick beds of pyroclastic formations. The lavae on the slopes of the valley form either rock wasted debris cones,or massive outcrops with unclearly-expressed spheroidal jointing. Sedimentary rocks in the section of the Irmalin series are not ascertained.

At the interstream area of the Charmak-Sai (eastern) and of the Rafak rivers (fig.I8,dr.23) the apparent thickness of the Irmaline series amounts 2200 meters.

Among the rocks of the Irmaline series organic remains are not discovered. Its Middle Triassic age is ascertained on the grounds of its concordant occurrence with the overlapping deposits containing marine fauna of the Middle Triassic age (Shukradarin series) only.

Apparently the volcanogeneous formations of the Irmaline series had been accumulating in a marime basin,which had a sublatitudinal strike, being confined to the marginal part of the Epi-Hercynian platform. A downwharp originated here as far back as at the beginning of the Permian period continued to develop during the Triassic time too. However in comparison with the Permian period during the Triassic time the tectonic movements had sharply activized and lead to the more intensive downwarping of it as well as to manifestations of volcanism. It is possible that this basin during the Triassic time was closed in the East and was opened in the West from the side of Herat,where normal marime rocks had been found being of Lower and Middle Triassic age in which the volcanogeneous formations (tuffs and tufosandstones) are subbordinated.

The S h u k r a d a r i n series.

The outcrops of the Shukradarin series deposits are established at the same places as of the Irmalik one,but in contrast to the latter they occupy more vast territories,composing wings of anticlinal structures. The total area of the outcrops amounts 60 sq.km.

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The Shukardarin series as it was pointed out above is concordantly lying on the rocks of the Irmalik series and with an unconformity overlapped by more yong deposits. To the West and to the South from the pass of Kara-Kotal as well as at another places the superimposition of the Karnii and Norii deposits of the Upper Triassic age with a basal conglomerated on this series is ascertained; to the North a transgressive superimposition of the Upper Cretaceous deposits or Miocene on the rocks of the Shukradarin series was observed. In the valley of the Ferozak river as well as in a number of another places owing to tectonic fractures (over thrusts,overturned bedding) a reverse relationships take place when the effusives of the Shukradarin series are "underlying" the deposits of Miocene what apparently served as a reason of an erroneous relation of them to the Miocene age (" ferozak beds") by some of the previous investigator (D.Veippert,I964).

The most part ofthe Shukardarin series is composed by effusives of acid composition- quartzy porphyries,felsite-porphyries,riolitic porphyries and their tuffs. The normally sedimentary rocks are gravellites,sandstones,argillites and limestones have a subborinate significance.

Quartzy porphyries are of grey colour with massive ,sometimes unclearly bedded structure. Texture of the rocks is porphyritic with microfelsitic,microgranite,rarely with spherolite ground mass. In impregnations of the rock (they sometimes amount up to 30% of the rock) there are quartz acid plagioclase (oligoclase-albite),dark-coloure mineral (completely chloritizated). The size of impregnations usually 2,rarely 5 mm. The ground mass is composed by quartz,albite, common potash feldspar,which sometimes forms spherolites and micrographic intergrowths in quartz. Biotite is rarely met. Rare impregnation of ore mineral and of sphene is usual. The size of the ground mass's granis is from 0,0I up to 0,I mm.

Felsitic porphyries have grey colour sometimes with greenish tint. Texture of the rocks is banded,rarely massive;structure is porphyritic with microfelsitic,rarely with vitrophyric and microgranitic ground mass. Impregnations amount up to I5% of the rock's volume,they are plagioclase (albite,oligoclase) and rarely almost completely chloritizated hornblende and biotite. The size of grains -up to 3 mm. The ground mass is composed by plagioclase,common potash feldspar,quartz. These minerlas form aggregate in which albite iscomparetively metamorphosed;its laths are oriented in one directionstressing fluidization of the rock. Besides it in the ground mass some quantity of uncrystallized glass and microfelsitic aggregate is present.The size of grains here does not exceed 0,3 mm. Secondary minerals -chlorite,calcite,sericite,zeolites,epidote. Amygdules filled by quartz, chlorite and zeolites are met also.

Tuffs of acid effusives - the rocks of grey ,dark-grey,greenish-grey, rarely of green colour. Their texture is massive,rarely unclearly bedded; structure is vitrolitocrystalloplastic psammitic,psammitic-aleuritic,rarely psephyto-psammitic one. Angular and semi-angular (with a size of up to 5 mm.) fragments of plagioclases,quartz,volcanic glass,microfelsitic aggregate and quartzy porphyries usually amount 30-40% of the rock's volume(rarely up to 80%). B asal(in most number of cases) cement has an ash structure. In its composition - small fragments of glass,volcanic ash,often replaced by chlorite,carbonate,sericite.In some cases a rare impregnation of an

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ore mineral,amygdules filled by quartz and zeolites are met.

Welded lavabrecciae and agglomeration lavae of acid composition have dark-grey,grey,sometimes greenish colour and massive,rarely bedded structure. They are composed by angular of different size fragments of quartzy porphyries,black siliceous rocks,cemented by ashy and glassy material.

Gravellites are of yellowish-grey,dark-grey coarse-bedded formations containing well and medium-rounded pebble the size of which being up to I cm.,composed by quartz as a main,black siliceous rocks and by dark-green effusives(porphyrites?). Cement is fragmental,calcareous-clayey.

Sandstones have grey,greenish-grey,dark-green,sometimes black colour and thin-laminated structure;the grains of quartz and of feldspars with the dimentions of 0,5-I,0 mm. are medium-rounded and cemented by carbonaceous cement. Structure of the rocks is psammitic and aleuropsammitic.

Argillites are of greenish-grey,dark-grey,black with brown tint colour,slightly calcareous,dense,thin-laminated with thin-platty jointing.

Limestones are grey,greenish-grey,dark-grey rocks with unclearly-bedded structure,sandy,medium-grained. They contain a great quantity of organogeneous detrital material.

For the Shukradarin series as well as for the Irmalik one the drawing up of a section by stratigraphical layers is connected with great difficulties because of tectonic complicasy of the region,great thickness lithological monotony of the rocks as well as for the lack of not quite good exposure of the rocks. The lower part of the section (up to 300-350 m.) at some areas is characterized by the accumulation of sedimentary rocks,however they areapparently quickly replaced by effusives along the strike.

At the interstream area of the Charmak-Sai(eastern) and Rafak river the following sectinn of the Shukradarin series (fig.I8,dr.23)the veryе bottom of it could be observed:

On the washed out(??) surface of the welded tuffs of basic composition related as far back as to the Irmalik series the following rocks are superimposed:

I. Interstratification of dark,almost black,dense conglomerates, composed by fine and medium pebble of quartz,blackchalcedony,slates,dark strongly distructed effusives,sandstones of grey-green colour with gravel,fine pebbles and fragments of petrifyed wood;tuffs of quartzy porphyry,quartzy porphyries,andesitic porphyries. The thickness of beds ranges from I,0 up to 3,0 meters..... 40,0 m.

2. Schists argillitic black with interbeds of aleurolite with vegetable detritus..... I2,0 m.

3. Sandstone fine-grained greenish-black with interbeds of aleurolites.....5,0 m.

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4. Welded tuff of quartzy porphyry of green-grey colour with vegetable detritus..... I0 m.

5. Sandstone fine-grained, tuffogeneous of green-grey colour, platty.. .....4,o m.

6. Quartzy porphyry of green-grey colour, also grey, pinkish..30,0 m.

7. Sandstone fine-grained of grey-green colour, calcareous, platty with non-determined remains of fauna..... II,0 m.

8. Conglomerate medium-pebbly of light colour, composed by pebbles of quartz, quartzy porphyry, black chalcedony with calcareous-chalcedony cement of interstitial type cement..... 3,0 m.

9. Sandstone fine-grained of green-grey colour, tuffogeneous, platty with interbeds of aleurolite..... 4,0 m.

I0. Tuff of quartzy porphyry of green-grey colour..... I5,0 m.

II. Interstratification of sandstones fine-grained of green-grey colour with the admixture of tuffogeneous material (up to I0%), aleurolites of the same composition, argillites of green-grey colour (thickness of beds is 0,3-I,2 m.) and rare beds of gravellite the thickness of which being 0,I-0,3 m. composed by fragments of effusive rocks (mostly of porphyrites) ....60,0 m.

I2. Argillite of green-grey colour calcareous with rare interbeds of aleurolite..... 37,0 m.

I3. Interstratification of green-grey sandy limestones and calcareous green tuffogeneous sandstones with the following fauna: Lepismatina sp., Mentrelia ex gr. ampla Bitt.(?), Afghanispira michailovi Daygs gen.et.nov., Aulacothyris sp., Coenothyris(?), Enxinella?sp., Pentacrinus sp.....30,0 m.

I4. Tuff of quartzy porphyry of green-grey colour..... 8,0 m.

I5, Aleurolite of green-grey colour with interbeds of fine-grained sandstone, the thickness of which being 0,5-0,6 m..... 6,0 m.

I6. Argillite of green-grey colour with interbeds of green-grey aleurolite the thickness of which being 0,I-0,3 m. and rarely of grey fine-grained sandstones with the thickness 0,2-0,6 m..... I3,0m

I7. Sandstones fine-grained of grey-green and yellowish-green colour with interbeds of aleurolite and dense grey sandstone with spheroides of grey-green aleurolite..... ..... 40,0 m.

Total apparent thickness ..... 336,0 m.

Above the section is not traced, limiting by dislocations with a break of continuity.

Along the strike the described rocks are apparently rapidly replaced by effusives so as for instance in the East, at the interstream area of the

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Ishpushta, Ferozak and Akhengaran rivers, as well as to the West from the pass of Kara-Kotal the effusives of basic composition of the Irmalik series above by the section are directly replaced by acid effusives of the Shukradarin series with a complete falling out from the section of normal sedimentary rocks.

In the section of the Shukradarin series the lavae of quartzy porphyrites and of felsite-porphyries which form thick (up to 200 m.) covers, divided by beds of lavabrecciae, welded tuffs and tuffs, being of less thickness are the predominant.

Total thickness of the Shukradarin series section amounts not less than 2 500 meters.

Organic remains, collected at the basement of the section of the Shukradarin series (from the bed No.I3 of the before described section) according to the conclusion of A.S.Dagis who had determined them are characterizing the upper parts of the Middle division of the Triassic system (Ladin-Karnii stages). The transgressive superimposition on the Shukradarin series effusives of the faunistically characterized deposits of the Karnii-Norii stages is apparently providing some foundation for the relation of the thick stratum of the Shukradarin series effusives as a whole to the Middle division of the Triassic system.

Accumulation of the Shukradarin series' deposits had apparently taken place in the same conditions as of the Irmalik series. At the initial stage of the sedimentation the locally manifested upliftings had apparently taken place which lead to the accumulation of shallow facies with brachippodic fauna and vegetation detritus. The further manifestations of the effusive volcanism with considerable eruptions of acid composition lavae again took place in the conditions of an intensive downwarping of the marine basin bottom.

The U p p e r Division

The deposits of the Upper division in comparison to the Middle one have more wide distribution, involving an area of 4I0 sq.km. They traced as a broken strip running via the whole investigated region from the coaly deposits of the Shabashek and Sary-Assiya in the West up to the basin of the Farkhar river in the East.

The Upper Triassic deposits, as it was pointed out above, are subdivided by us into Karnii, Norii and Ret stages. The Karnii and the Norii stages could be subdivided according to the found fauna in the section near the village of Doabi-Mekhzarin only, where these deposits were studied in details and nowhere on the rest part of the area for the lithological

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monotony and poorness by organic remains. In connection with this on the enclosed geological map as well as in the text of the present report the Karnii and Norii stages are considered together and only when describing the section in the region of the Doabi-Mekhzarin village according to our materials as well as according to the materials of the previous investigators (G.N.Khatiskatsi, A.K.Dertev and others,I963),the Karnii and Norii stages are dissected (fig.I9,dr.24).

The Ret stage on the most part of the investigated territory is lithologically sharply isolated from the underlying rocks,being mainly composed by volcanogeneous formations of basic and acid composition,as it was already pointed out above.

In the Central regions of the investigated territory on the grounds of difference in lithological composition the Ret stage is dissected into two series: the lower one-the Ishpushtin and the upper one-the Turmush series.

On the eastern part of the investigated territory (to the East from the Surkhab river) effusive formations of the Ret stage compose an united undissected stratum and are singled out by us on the geological map as well as in the text as the Ret undissected stage.

Separate outcrops of the Ret stage in the region of Pul-i-Khumry town are characterized by spesific,different from the other sections lithological composition;they had been singled out in this region by the previous investigators (A.M.Makhnev and others,I962) under the denomination of " Pul-i-Khumri series". On the geological map as well as in the present report these deposits have their previous denomination though even now one can consider that they could be parallelized most probably with the upper part of the Ret stage,namely with the Turmush series of the South-Central regions.

Quite isolated are the outcrops of the terrigeneous-sedimentary rocks,probably of the Ret stage in the region of the coaly deposit of the Shabashek ,where they are singled out under the denomination of Cheldukhtaran series. From the point of their age these deposits apparently did not limit by the margins of the Ret stage only,but probably involve more old deposits.

Below the subsequent description of the singled out deposits of the Upper division is given.

The K a r n i i - N o r i i stages,undissected

The deposits of the Karnii-Norii stages have as in the whole the area of nearly to 200 sq.km.,but could be observed on a considerable

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space. Their separate outcrops with an area of from I up to 70 sq.km. (more often 5-20 sq.km.) are mainly observed in the medium part of the investigated territory,beginning from the region of the coaly deposit of the Sary-Assiya in the West up to the up-stream of the Kush-Darra sai in the East (40 km. to the East from the village of Doshi);in the South their last outcrops were observed by the valley of the Saihan river;in the North their distribution is mainly limited by the latitude of the Kampirak village. Small outcrop of the describing deposits is observed in a core of an anticlinal fold of the Khalivberda (at the left tributaries of the Kaftarkhan river) near the northern margin of the investigated region.

The deposits of the Karnii-Norii stages lie on different by age deposits with sharp angular (up to 90°) and azimuthal (up to 60°) unconformity. On the most part of the area (in the valley of the Saihan river and further to the North-East by the valley of the Surkhab river up to the river of Ishpushta,in the structure of Khalifberda,in the region of the Kampirak village as well as at the interstream area of the Kush-Darra and Piez-Kul rivers) the describing deposits are directly lying on the Lower Paleozoic rocks of the Siyadarin series. On the more limited areas the superimposition of the Karnii-Norii deposits om the limestones of the Durumbak series (Sillurian-Devonian),on the schists and limestones of the Tundarin series (Upper Devonian-Lower Carboniferous) as well as on the Lower Carboniferous deposits (the mouth of the Saihar river near the village of Doabi-Mekhzarin and at the left slope of the Saidi-Kaion river) is observed.

On small areas in the Central part of the region the Karnii-Norii deposits lie with a washout on the effusives of the Shukradarin series (Kara-Kotal pass) or on those of the Irmalik series (the up-streams of the Surkhala river) of the Middle Triassic age.

In the sections of the Karnii-Norii stages the predominant distribution have argillites,often aleuritic and micaceous,aleurolites,sandstones,conglomerates,very seldom -coaly argillites with small lenses of hard coal.

Argillites are of dark-grey,grey,greenish-grey or of tabaco colou unclearly - bedded or thin-laminated,on the surface they have a characteristic fine-fragmental or"penciled" waste rock. Under a micoscope the rocks represent by themselves a homogeneous pelitic mass in which an admixture of aleuritic grains,being non-rounded at all and represented by quartz,flakes of sericite,rarely by semi-decomposed feldspar is developed more or less regulary and amounts from 5 up to IO%; in some varietie

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is encreased up to 20% and more apparently forming the transitional varities to aleurolites. Texture of the rocks is pelitic,aleuropelitic.

Argillites coaly are of dark-grey up to black colour,unclearly bedded they give a thin-platty rock waste.

Under a microscope the rock is represented by homogeneous pelitic mass,coloured by spots in brown up to black colour. In some sections it is slightly translucent. Inclusions with a size up to I-2 mm. composed by coaly structureless matter,rarely charred fragments of vegetation substance are marked. The admixture of aleurolitic material reaches I5-20%. Texture is pelitic,aleuropelitic

Aleurolites are polymic of grey,greenish-grey colour,dense,unclearly-bedded.

Under a microscope the rock is composed by slightly rounded or sharp-angular grains of quarta (up to 30%),kaolinizated or serititizated feldspar (up to I0%),grains of dark chalcedony (5-8%),flakes of muscovite (5-8 %) with the size of from 0,0I up to 0,I mm. Fine sandy admixture (up to I0%) is often present here also. Cement is of interstitial type and is composed by yellowish-grey or grey clayey serititizated mass(up to 30-35%). Texture is aleuritic,aleuro-pelitic. Structure is irregular.

Sandstones polymic are of grey,greenish-grey colour,dense,unclearly-bedded.

Under a microscope the rock is composed by slightly rounded,often by sharp-angular grains of quartz(30%),feldspars(5-6%),fragments of quartsite and black chalcedony (I5%),quartz-sericite and chlorite-sericite schists (up to 20%),effusive rocks,apparently of acid medium or basic composition(up to 5%).Singular grains of epidote,ore mineral. The size of grains ranges from 5-6 up to I-I,5mm. Cement (25%) is sericitic with an admixture of aleuritic material of interstitial type. Structure is psefitic,transforming into psammitic one. Texture is irregular-grained.

Sandstones quartz-feldspatic are of pinkkish-grey,pinkish-greenish-grey colour,dense.

Under a microscope the rock is represented by angular,rarely slightly rounded grains of quartz(55%),feldspar (up to I5%)-andesine and orthoclase,fragments of schists,quartzites,effusives(5%) and flakes of muscovite,rarely of biotite(up to 5%). Singular grains of ore minerals,rutile, epidote. The size of grains is from 0,2 up to 0,8 mm. Cement (20%) is of interstitial type,rarely contact siliceous,siliceous-sericitic with an admixture of fine aleuritic material.

Conglomerates polymict of greenish-grey colour,fine-and rarely medium pebbly,dense.

They are composed by poorly rounded ,sometimes angular pebble ofwhite quartz (up to 25%),black and grey chalcedony(up to 20%),fragments of green and black schists (up to I5%),quartzite-like sandstone (up to I0%). Cement (up to 30%) is siliceous-sericitic,of interstitial type,rarely basal one. Texture is psefitic. Structure is irregular.

The structure and the thickness of the Karnii-Norii deposits' sections within the limits of the investigated territory are not constant.

In the region of the Doabi-Mekhzarin village a very complete section of the describing deposits could be observed(fig.20) which is subdivided by us as well as by the previous investigators into Karnii and Norii stages (G.N.Khatiskatsi,A.K.Dertev,Ju.V.Pashkov,I963) and into a number of lithologically different benches(fig.I9,dr.24).

The deposits of the Karnii and Norii stages in the region of the Do-

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abi-Mekhzarin lie with angular (up to 30°) and azimuthal (up to I5°) unconformity on the calcareous-sandy-schistose deposits of the Vise stage and are apparently with a break overlapped by volcanogeneous-sedimentary series of the Ret stage.

The lower part of the section,related to the Karnii stage in the region of the Doabi-Mekhzarin village is clearly subdivided into three benches (from the bottom):

I. Conglomerates of red-brown,greenish,grey colour,pebbly ones(from fine-up to coarse-grained) with an admixture of boulders (the size being up to I m.). They are slightly sorted and bedded at the upper part of the section,where interbeds and lenses of sandstones and gravellites up to 0,3 m. are marked,and being non-sorted at all at the lower part of the section. Cement is sandy-gravelly-clayey,dense,slightly carbonaceous one. Pebbles and boulders are medium and poorly rounded and composed by Paleozoic grey limestones,red-brown and grey quartzite-like sandstones,medium- and fine-pebbly dense conglomerates,rarely of effusives of basic and acid composition. Among sandstones of the upper part of the bench - fine undetermined fragments of shells' valves.

Thickness is ..... II5,0 m.

A.K.Dertev in I963 valuated their thickness in the same region as to be 24I,5,probably 300,0 meters.

D.Veipert (I964) singled out them as Lower Doab coarse-fragmental beds with probable change of thickness from I up to 250 m.

These conglomerates indeed have a very irregular and sharply ranging thickness from 300 m. up to complete pinching out. It could be well observed when tracing the bench from the village of Doabi-Mekhzarin to the North. For example,almost at the mouth of the Ishpushta river one can see the greenish-black argillites with interbeds of grey sandstones of the Karnii stage lie directly on the phyllite-like schists of the Siyadarin series of the Lower Paleozoic age.

On the described conglomerates of the bench No.I the following rocks are superimposed:

2. Argillites of black colour calcareous,aleurolitic,dense,fine-fragmental,rarely platty with interbeds being in the thickness 0,05-0,I m. of polymic aleurolites and fine-grained sandstones being of dark-grey and grey colour (fig.20). Among argillites concretions of black siderite with fine seggregations of pyrite and abundant of fauna are often met. From this part of the section the following fauna had been collected: Gruenwaldia sp.aff.decussata Miinst,Sturia(?) sp.,Daonella sp. Lopha sp.,Anadontophora sp.,Jsognoman sp.,Meecoceras(?) sp.,Pseudomonotis Eumorphotis sp (collection made by A.K.Dertev,I963,determinations carried out by V.I.Kuz

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netsova and E.A.Repman),and during more early period the following forms had been collected: Monophyllites cf.sp.hacrophyllus Hauer,Daonella cf.moussoni Mer.,Cevafites afghanicus fuvon,C.afghanicus Furon vor.zaheri Fuv, C.afghanicus Fur.,Tracyceras sp.(collection of R.Furon and L.Rosse, I95I).

The thickness of these deposits is ..... I4I,0 m.

3. Argillites of black colour,calcareous,slightly calcareous,dense, fragmental,almost without interbeds of aleurolites and sandstones and without concretions of siderite. Among them marks of Pseudomonotis sp., Daonella sp. valves are oftem marked.

The thickness is ..... 55,0 m.

The benches 2 and 3 Xx by D. Veippert (I964) are singled out as Middle Doab marble-clayey beds with variable thickness from 0 up to 250m

A.K. Dertev in I963 described them together as "P bench" and indicated the total thickness being I65,0 m.

The benches 2 and 3 as well as the bench No.I according to our observations have a variable thickness and limited distribution. As far as in the neibouring sections (the region of Ishpushta,the valley of the Saihan river) they are not observed.

The second feature of these deposits (bench No.2) is the presence in it of mixed fauna of Lower-Middle and Upper Triassic age.

A.K.Dertev,for example, indicated for incompatible being of such ammonites as Meecoceras sp. (the Lower Triassic form) and Sturia sp.(the Middle Triassic of Europe and Asia and rarely Upper Triassic of Europe) as well as Gruenwaldia (Upper Triassic ofEurope).

R.Furon and L.Rosse (I95I) indicate that side by side with Monophyllites cf.sp.haerophyllus characteristic for the Annii stage there present ceratites of the Upper Anizii and Ladin age,ammonites Trachyceras sp. and Sturia Sansovinii v.Mojs of the Ladin-Karnii age,pelicipodae Daonella cf.moussoni Mar of the Ladin stage.

A.K.Dertev marks an interesting fact of the Middle Triassic forms presence (ammonites and pelecipodae) among siderite concretions in lenses of tuffs,while such form as Gruenwaldia sp.aff.decussata Miinst which is typical for the Karnii deposits was not marked in concretions of siderites,but widely distributed among argillites and sandstones. This fact allowed A.K.Dertev to express a supposition that some of the forms are redeposited.

With this supposition inspite of the abscense of evident phenomenon of rewashing one ought apparently to agree. To this fact we can add a supposition on the fact that redeposition apparently took place together with concretions of siderite to which for example could indicate the

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find of siderite concretion's fragment (one half of concretion),as well as traces of concretions' regeneration,providing the impression of their cohesion with the rock in argillites.

On the described rocks the following occur with a conformity:

4. Sandstones and aleurolites of gray,renaly of greenish-gray colour being inequigranular,polymic,in some interbeds slightly calcareous,laminated. Separate beds have the thickness from 0,I0-0,I5 up to 0,8,rarely up to 2,0 meters. Sandstones contain lenses of gravellite,small pebbles rarely small boulders,among which granites are marked. Irregularly by the whole stratum interbeds of black,sometimes slightly coaly argillite,the thickness of which being from 0,I0 up to 0,70 m. are marked. The stratum has a flyshoid character. Argillites contain small siderite concretions. Among sandstones sandy-limonite concretions could be met. Argillites and aleurolites (at the middle part) contain vegetation remains,mainly of equisetums and small detritus. Argillites contain remains of pelicipodae remains Pseudomonotis sp.,those of cephalopodae - Cladiscites sp.(aff. folli Diner) (collection of A.K.Dertev,determination by V.I.Kuznetsova)

The thickness of this bench is ..... 425,0 m.

Apparently the same bench is marked by D.Veippert(I964) under the denomination of the Upper Doab sandy-fragmental seams with the thickness from I00 up to 200 m. D.Veippert supposes that the rocks of this bench are replaced along the strike by " the Doab volcanites" what is not confirmed by us.

A.K.Dertev singles uot the described rocks as " III bench" being in the thickness 240,0 m.

According to A.K.Dertev by the roof of this bench we draw a boundar line between the Karnii and Norii stages.

The summary thickness of the Karnii stage in the section of the Doabi-Mekhzarin according to our data amounts 736,0 m.,what is well correlating with A.K.Dertev (nearly 700,0 m.) and with the data of D.Veipper (700 m.,the maximal mesures)

The upper part of the section being related to the Norii stage in the section of Doabi-Mekhzarin (fig.I9,dr.24) is quite clearly separated from the underlying deposits of the Karnii stage both by fossils and by lithological peculiarities. Here concordantly on the deposits of the Karnii stage the following rocks are accurring:

I. Interstratification of grey,greenish-grey aleurolites (thickness of beds being 0,05-0,20 m.) and black fragmental argillites with rare concretional interbeds and lenses or with separate niggerheads of dark-grey up to black clayey siderite with thin films of pyrite by fissures.

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Concretions often contain small valves of pelicipodae,fragments of ammonites,vegetation detritus. From this stratum the following remains are collected and determined by V.I.Kuznetsov: Monotis aff.salinavia Bron.M. daonellaeformis Kipav. Interbeds of grey polymic fine- and medium-grained dense sandstones with vegetation detritus and casts of equiseums are often met here.

The thickness is ..... 66,0 m.

2. Aleurolite grey,green-grey,polymic,dense with interbeds being in thickness 0,I-0,2 m. of sandstone and rarely of black argillite at the upper part,the thickness of this stratum being ..... . 22,0 m.

3. Regular interstratification of grey,greenish-grey aleurolites and fine- medium-grained brownish-greenish sandstones. At the upper part of the bench the interbeds of black argillite are met. Thickness of separate interbeds ranges from 0,I up to 0,5 rarely up to 0,8 m. Here seldom small vegetation detritus is met. Concretions of siderite are absent or extreamly rare.

The thickness is ..... I83,0 m.

4. Conglomerate fine- and medium-pebbly of greenish-grey colour,dense. It is composed by poorly and medium rounded pebble of quartz,black chalcedony,dense argillite,limestone,metamorphic schists (rare). Cement is quartz-sericitic.

The thickness is ..... 2,0 m.

5. Interstratification of aleurolites and sandstones,analogical to the bed No.3.

The thickness is ..... I2I,0 m.

6. Conglomerate analogical to the bed No.4. The thickness is ..2,0 m.

7. Interstratification of aleurolites and sandstones ,analogical to the bed No.4. The thickness is .....30,0 m.

Total apparent thickness by the section is ..... 406,0 r

The described deposits of the Norii stage were confirmed also before by analogical fauna,collected in this section by A.K.Dertev(G.N.Khatiskatsi and others,I963);the thickness in general is also concurs. However "the covers" of diabases and diabase-dolerites,described by A.K.Dertev from this part of the section being in thickness 78,45-50 and 40 m., confined to the upper and middle benches (V and VI benches according to A.K.Dertev) are related by us to intrusive sheets,which are alike to those observed in the region of the Doabi-Mekhzarin hotel as well as in the region of Ishpushta,where their intrusive character is confirmed by the mode of their occurrence (fig.22).

The deposits of the Norii stage of the Doabi-Mekhzarin region were

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probably accumulated in the conditions of shallow epicontinental sea, to this fact the pelicipodic fauna is also testifyes. The accumulation of sediments took place in the conditions of continuous downwarping of marine basin bottom, being of irregular-pulsating character, by what is apparently conditioned the flyschoid character of deposits' interstratification.

At another areas, where the Karnii-Norii deposits outcrop, considerably more desreased their thickness is in general marked. This is apparemtly conditioned by the falling out from the section of (the Karnii) its parts as well as by the further erosional processes (Pre Jurassic and Pre Upper Cretaceous).

From the village of Doabi-Mekhzarin to the South-West the Karnii-Norii deposits are continuously traced up to the mouth of the Saihan river where they occur on the Lower Carboniferous (Vise) and on the Sillurian-Devonian (Durumbak seires) deposits. Basal conglomerates here being composed by fine and coarse-medium well rounded pebbles of metamorphic rocks, marbled limestones and quartzite-like sandstones have a thickness up to 20 m. On conglomerates the interstratificating black or green-grey (taboco) fragmental micaceous aleurolites and fine-grained greywack sandstones are occuring. The thickness of interbeds is from 5-I0 up to 50-60 cm. At the contact with diorites cutting them they form characteristic banded hornfels. This part of the section is lithologically alike to the upper parts of the Karnii and lower parts of the Norii stages of the Doabi-Mekhzarin section.

Summary apparent thickness of them here does not exceed 200 meters.

Further to the West-South-West the outcrops of the describing deposits in the alike facies had been ascertained at the medium course of the Saihan river. Here they transgressively superimposed on the metamorphic rocks of the Siyadarin series and being overlapped by the rocks of the Senoman age also transgressively . At the basement of the section they are represented by greyish-brown conglomerates, the thickness of wich being up to 35 m. Above by the section conglomerates are replaced by interstratification of sandstones, aleurolites, gravellites and dark-grey argillites, containing concretions of siderite.

The apparent thickness of them here does not exceed .... 350,0 m.

Further to the South the Karnii-Norii deposits are known in the region of the Kara-Kotal pass, mainly to the West from it. Here on acid and basic effusives of the Middle Triassic age with a washout lie dense medium-and coarse-pebbly with small boulders of greenish-black conglomerates with interbeds the thickness of which being 0,I-0,3 m, of greenish-grey sandstone and aleurolite. The pebbles of conglomerates is composed

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by diabases, crystalline schists, rarely of quartzy porphyries, quartz and grey-green argillites. Some beds have a thickness of 0,7-2,0 m.

Total thickness of conglomerates is ..... 350 m.

On them concordantly lie alternating dark-grey with green tint (tabacco) argillites, interstratificating with aleurolites, sandstomes and gravelly conglomerates. Aleurolites and argillites are the predominant. An apparent thickness is ..... 200 m.

The deposits of the Karnii-Norii stage here have redcoloured crust of weathering and are overlapped by coal-bearing Lower-Middle Jurassic deposits.

The marginal eastern outcrops of the Karnii-Norii deposits are known to the East from the Doshi village, at the upper part of the Piez-Kul river basin. Here limited outcrops of intensively dislocated (occurring under the angle of 50-80°) Kornii-Norii deposits occurring on schistose stratum of the Lower Paleozoic (the Siyadarin series) with sharp angular unconformity as well as concordantly(?) overlapped by volcanogeneous formations of the Ret stage are observed. Further to the East (the region of the Nakhrin village) and to the North (the region of Pul-i-Khumri) the volcanogeneous deposits of the Ret stage are everywhere occurring directly on the Paleozoic deposits.

For a considerable turfness one can by separate outcrops ascertaine that the main rocks in the section of the Karnii-Norii deposits are the interstratificating greenish-brown micaceous argillites, tuffogeneous sandstones, greenish-brown aleurolites, grey-green gravellites, fine-pebbly conglomerates and tuffs of medial composition. Seams of sedimentary rocks have the thickness from 0,2 - 0,8 up to I0 m. Tuffs form rare seams from 3 up to I2 m. Among the brown-green argillites the remains of fauna Halobiidae were met, which have a distribution within the limits of the Middle-Upper Triassic age. The apparent thickness of the Karnii-Norii deposits here is not less than ..... 350 m.

To the North-West from the Doshi village, in the region of the Kampirak village (fig.23, dr.26) the Karnii-Norii deposits are outcropping on a considerable area. Here they occur on the rocks of the Lower Paleozoic age with angular unconformity and are represented by sandstones and conglomerates (from 7-8 up to 20 m.) at the foot of the section and by sandy-argillite stratum - at the upper part of it. Sandstones are of red-brown colour, polymic with unclear cross bedding, sometimes with pebble composed by metamorphic schists and marbled limestones, they contain lenses of conglomerates of the same composition and at some places in a considerable degree are replaced by them. On sandstones and conglomerates lie inter-

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stratificating green-grey (tabacco) argillites,aleurolites and sandstones. Sandstones and aleurolites are the predominant and form seams from 0,2 up to 0,8 m. in thickness. Sandstones form rare seams the thickness of which being up to I,5 m. In argillites the remains of Pseudomonotis fauna had been collected.

The apparent thickness of the sandy-argillitic deposits in the region of Kampirak does not exceed 500 m.

To the East and North-East from the valley of the Piez-Kul river the sandy-argillitic facies of the Karnii-Norii stages are usually not observed. As it was pointed out above, in these regions the effusive formations which are related by us to the Ret stage occur directly on the Paleozoic rocks. It makes possible to suppose that the eastern boundary of the Karnii-Norii marine deposits' distribution runs approximately by the latitude of the interstream area of the Kush-Darra and Nakhrin rivers.

From the North the distribution of the Karnii-Norii deposits is limited by latitude of approximately 35°55'. However in the region of the Rui village this border is deflected to the North. Here in the left tributaries of the Kaftarakhan river,near the village of Khalivberda,in the core of an anticline fold,directly on the Paleozoic schists,having a thick crust of weathering the Upper Triassic deposits occur with angular unconformity (fig.24,dr.2I).

They are represented mainly by basal pebbly-boulder conglomerat (pebbles have a diameter of up to 0,50 m.) composed by pebbles of underlying rocks of Paleozoic age (quartzite-like and micaceous schists,quartzites,hornfels black-coloured,quartz-sericitic schists,black limestones with the remains of Vise fauna,marbled limestones,etc.) medium-and well rounded,cemented by dense sandy-siliceous cement. The thickness of conglomerates is not constant and ranges from 0 up to 8-I0 m. Above usually occur green-grey thinplatty or fragmental argillites,interstratific ting with sandstones,gravellites and conglomerates (beds with a thickne from 0,I0 up to I,50 m.). Composition of conglomerates is the same as t basal ones;small boulders are often met. At the western part of the out crop argillites are the predominant in the section. While tracing the rocks to the East at the distance of 2-3 km. it is noticeble that in th section sandstones,gravellites and conglomerates gradually begin to be the predominant. The latter are formed by medium and large pebble and by boulders and form seams and lenses with the thickness being upto I0 It is possible that such a repacement of the section by coarse-fragment rocks testify to the nearness of a coastal line and to the presence of active sources in a form of mountain structures or of considerable up-

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liftings, being intensively dissected by erosion. The latter apparently were located to the North and North-East from the Khalivberda.

The sections of the Karnii-Norii stages, being of somewhat another character were observed in the Central parts of the investigated region- by the valley of the Aokhorak river and ne ar the village of Doabi-Shakhpasand as well as by the valley of the Saidi-Kaion river in the region of the Kyzyl-Kala (the Irmalik sai and others) village. These sections apparently correspond to the central areas of a marine basin and have the greatest thickness and more fine-grained character of the deposits.

In the valley of the Saidi-Kaion river on the Paleozoic rocks (Devonian-Carboniferous) with angular unconformity occur basal conglomerates, gravellites and sandstones of greenish-grey and grey-green colour, the thickness of which being from the first meters up to 20-30 meters. On conglomerates the series of monotonous by the composition and colour black and greenish-black micaceous phyllite-like schists with rare thin interbeds of dark grey-green fine-grained dense polymic sandstones is lying. Their apparent thickness is Some more than 500 m.

Further to the West in the valley of the Akhenharan river (sai of Irmalik and others) a thick series of analogical rocks is outcropping. Here at the basement, as well as at another places an irregular seam of interstratificating brown-grey medium-and fine-grained conglomerates, composed by well and medium rounded pebbles of quartz, quartzite-like sandstones, rarely of grey limestones, crystalline schists, effusives of medial and acid composition and marbles, densely cemented by sandy-clay-ey-siliceous cement, being of green-grey up to black colour argillites, dark-grey aleurolites and rare seams of medium-grained tuffogeneous sandstones is observed. Among conglomerates rare lenses of coarse-grained conglomerates of the same composition and rare boulders and even blocks of grey limestones are met. The thickness of a conglomerate benc is not constant. In the direction to the North (up-streams of the Akhenharan river) it reaches the thickness of 300 meters. Above the basal conglomerate bench lie greenish-black, often black platty or fine-fragmenta micaceous argillites, sometimes flischoide ones with interbeds of aleurolites and polymic, often tuffogeneous sandstones (interbeds have a thickness from 0,2-0,3 up to I,5, rarely up to 7 m.). Sometimes beds with a thickness being up to I0-I5 m., composed by lavae, welded tuffs of medial rarely of acid composition and of by lavabrecciae are met. The black varieties contain vegetation detritus. In aleurolites and argillites organic remains of poor preservation are sometimes met: Holobia sp., Halobia aff.tropita Kittl.

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To determine the thickness of the described Karnii-Norii deposits in the basin of the Akhenharan river for a considerable their dislocation (folds with angles of dipping from 20 up to 70°, numerous ruptures) more correctly is impossible. However a number of particular mesures and approximate calculations with the help of graphical method give figures being within the limits of 800-900 m.

In the region of the Doabi-Shakhpasand village (Doab Tatar) the deposits of the Karnii-Norii stages have a somewhat spesific composition. Here in the section a great number of calcareous sandstones' seams, separates rare interbeds of which sometimes contain poorly preserved undetermined remains of calcitizated shells of pelicipodae and gastropodae is met. Sandstones are alternating with aleurolites and argillites, which contain lenses of black coaly argillite with thin interbeds of hard coal.

Incomplete section near the village of Doabi-Shakhpasand (Doab Tatar) has the following structure (from the bottom):

I. Argillite black, in some interbeds slightly coaly, foliated with thin interbeds of fine-grained sandstones and aleurolites being 0,05-0,I5 m. in thickness - the apparent thickness is ..... 60,0 m.

2. Sandstones of grey colour, fine-grained, bedded.....20,0 m.

3. Argillites black in some interbeds dark-grey, foliated micaceous with interbeds of sandstones the thickness of which being 0,0I-0,05 m. and rare more thick seams of sandstones being in the thickness from 0,20 up to 0,80 m., total thickness is ..... 60,0 m.

4. Sandstones finegrained grey, micaceous..... I5,0 m.

5. Argillite black, dark-grey foliated, micaceous with interbeds of fine-grained sandstones and rare interbeds of coaly black argillite at the upper part of the bench ..... 60,0 m.

6. Sandstone grey fine-grained, sometimes cross-bedded.....I5,0 m.

7. Argillite black micaceous with interbeds of sandstones, the thickness of which being from 0,I0 up to 0,80 m. and with rare more thick interbeds of from 2-3 up to 6 m. in the thickness; the thickness of sandstone's seams to the upper part of the bench is decreasing. At the top -there are coaly argillites with thin (up to I-2 mm.) interbeds of sparkling coal and small carbonificated vegetation detritus,..40,0 m.

8. Sandstones grey fine-grained, bedded, at some places cross-bedded dense with lenses of gravellites and rarel pebbles of white quartz, black chalcedony and other rocks..... 20,0 m.

9. Argillite black, foliated with thin interbeds of fine-grained polymic sandstones..... 30, 0 m.

I0. Interstratification of grey dense sandstones with the thickness

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being from 2-3 up to 6 m. and of black argillites the thickness of which being from I-I,5 up to 3,0 m., total thickness is ..... 20,0 m.

II. Argillite black strongly coaly with interbeds the thickness of which being I,50 m., composed by medium -and fine-grained sandstone at the middle part of the bench and with thin interbeds of aleurolite. At the upper part of the bench among coaly argillites there are lenses of hard coal with the thickness being I-2 cm., total thickness is 20,0 m

I2. Sandstone grey fine-grained dense, at some places with lenses of gravellite and small pebbles. Cross bedding is noticeble here.....

...the apparent thicksness is ..... 20,0 m.

Total thickness by the section amounts ..... 380,0 m.

Further to the East one can see how the described section is built up by the analogical rocks, with the total thickness not less than 200 m. At the upper part of the section benches of coaly argillites, interstratificating with aleurolites and contaning lenses of hard coal with the thickness of them being up to 0,35 m. are marked.

Thus, the total apparent thickness of the Karnii-Norii stages in the region of the Doabi-Shakhpasand village amounts not less than 580 m. and the complete thickness apparently must be not less than I000 meters.

The lower parts of the section have features of sedimentation of deposits in comparetively opened marine basin, though not very much remote from the sources of terrigeneous material removal. The upper parts, containing more seams of coaly argillites and interbeds of hard coal-were deposited in near-shore zones of a basin, which were periodically dryed out and swamped. It is posssible that the most upper parts of the section of the Doabi-Shakhpasand region are related to the upper parts of the Norii stage, or probably to the transitional beds to the Ret stage though this supposition remains to be not proved yet.

At the distance of 8 km. to the North-West in the valley of the Khajazat river in a small erosional window the rocks analogical to the described ones in the lower part of the section of the Doabi-Shakhpasand are outcropping. Here they contain interbeds of sandy coquina with the thickness being up to020 m. with the same poorly preserved black calcitizated undetermined shells of pelecipodae and gastropodae. In interbed of aleurolites and argillites concretions of siderite being of rounded form or lens-like concretional accumulations (interbeds) with the thickness being up to 0,05 m. could be met. Here also the imprints of equisetums and small vegetational detritus are marked.

In the region of coaly deposit of Sary-Assiya (sai Chaulikhan) the following incomplete section (fig, 25, dr.22) of the Karnii-Norii depo-

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sits (from the foot) could be observed:

I. Interstratification of sandstones fine-grained, of light-grey colour usually underlied by aleurolites and carbonatizated vegetation detritus, and of grey, dark-grey, brownish-grey argillites. The thickness of separate beds ranges within the limits from 0,2-0,3 up to 0,8 m....98,0 m.

2. Sandstones fine-grained cross-bedded, light-grey..... 23,0 m.

3. Interstratification of beds, composed by sandstones being micaceous, quartzy, cross-bedded with vegetation detritus and of aleurolites being of brownish-grey, grey, micaceous, platty with carbonatizated detritus of vegetation. The thickness of separate beds is from 4 up to 6 m. The total thickness of the bench is ..... 48,0 m.

4. Argillite coaly of brown-grey colour with chared remains of plants and small lenses (up to 0,5 cm.) of sooty coal..... I6,0 m.

5. Interstratification of sandstones and aleurolites, analogical to the described in the bed No.3. At the lower part of the bench there are many of coaly argillites, being black, brown-black in colour, which compose between the beds of sandstones, being in the thickness 4-6 m., the interbeds up to 3-5 m. in the thickness. At the lower part of the section - aleurolites of grey colour, thinbedded occurring with a wavy boundary of a washout on the underlying rocks..... 56,0 m.

6. Interstratification of seams of sandstones, being micaceous, cross-bedded with remains of plants, of aleurolites being of brownish-grey colour, micaceous with chared remains of plants and of argillites being grey and thin-platty. Sandstones in separate beds have characteristic rusty spots. The thickness of beds is from 2-3 up to 5-6 m.... I00,0 m.

7. Tuff ashy fine-grained of brownish-green colour being of cloddy structure, dense with inclusions of volcanic bombs..... 62,0 m.

8. Interstratification of brown-grey and dark-grey aleuritic argillites and green-brown clayey aleurolites, sometimes cross-bedded with wooden remains also being micaceous. At the lower part of the bench the thickness of argillitic and aleurolitic beds is respectively 3-5 m. and I-I,5 m. At the upper part of the bench the thickness of beds ranges respectively for aleurolites 0,3 m. and fro argillites up to 0,5 m.

Total thickness of the bench is ..... II2,0 m.

9. Sandstone fine-grained polymic thin-bedded with chared remains of plants, with thin interbeds of green-grey aleurolites and argillites, with unclear imprints of shells. At the lower part of the bench there is an interbed of shell limestone with numerous black calcitizated undetermined shells of pelecipodae..... 23,0 m.

Disappearance of outcrop is nearly 50 m. The continuation of the section is observed at the distance of 0,3 km. to the North.

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I0. Interstratification of sandstones being fine-grained, grey loose with the thickness of interbeds being 0,2-0,5 m., and sandstones also being fine-grained, but light and dense with the thickness of interbeds being 0,I-0,2 m., and also of almost black foliated micaceous aleurolites with the thickness of interbeds being 0,4-0,8 m. Sandstones are the predominant..... 20,0 m.

II. Sandstone fine-grained dense light-grey with thin interbeds of argillite being black, foliated and micaceous. The beds have the thickness from 0,I up to I,5-2,0 m. Total thickness is ..... I8,0 m.

I2. Argillite black foliated micaceous with interbeds of black sandy aleurolite..... 5,0 m.

I3. Sandstone fine-grained dense, interstratificating with dense foliated aleurolite. Thickness of the beds is from 0,03 up to 0,20 m. Total thickness of the bench is ..... 2,5 m.

I4. Sandstone fine-grained dense grey with ferruginized spots and strip with interbeds of aleurolite and rarely of foliated micaceous argillite with the thickness being 0,05-0,0I m. Total thickness is ....22,5 m.

I5. Interstratificating of argillites being of black colour, micaceous, of dark-grey aleurolites, being foliated and micaceous and of sandstones being fine-grained, dense and platy..Thickness of beds is from 0,I0 up to 0,80 m. Total thickness of the bench is ,,.....II,6 m.

I6. Sandstone fine-grained grey dense with diagonal bedding..I3,5 m.

I7. Thin interstratification of black argillite, slightly micaceous and dark-brown aleurolite. The thickness of interbeds is I-5 cm. Total thickness of the bench is ..... 2,0 m.

I8. Sandstones fine-grained grey, unclearly-bedded, slightly ferruginized, with rare interbeds of black micaceous foliated argillite, the thickness of which being 0,I-0,2 m., rarely of aleurolite, also being foliated ..... I5,0 m.

I9. Interstratificating of benches of argillite, being of black, greenish-black colour, micaceous, foliated with thin interbeds (I-5 cm.) of green-grey aleurolite and fine-grained light-grey slightly ferruginized sandstone. At the lower part of the bench the beds of argillite have a thickness being from I,5 up to 2,0 m., the latter for sandstones -from 2 up to 8 m. At the upper part of the bench argillites with interbeds of aleurolite of green-grey colour gradually become the predominant. Here round concretions of siderite with the size of up to I0 cm. in diameter are marked. Sandstones sharply decreased in the quantity of benches, though their thickness reaches 3-5 m. The apparent thickness is 235,0 meters.

Total apparent thickness is ..... 953,0 m.

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The complete thickness of the Karnii-Norii deposits in the region of the Sary-Assiya is without doubt more than it is indicated and apparently could reach I200-I500 meters.

To the South-East from the village of Sary-Assiya, in the basin of the Aokhorak river, the Karnii-Norii deposits are represented by monotonous interstratification of black fragmental argillites with carbonatizated vegetation detritus, with almost black clayey aleurolites or with rare interbeds of grey-black fine-grained sandstone with the thickness of the interbeds being 0,I-0? m. Argillitea are sharply predominant. In separate beds and benches they are coaly and contain rounded concretions of siderite of black colour with the diameter being up to I0-I5 cm. and with abundant carbantizated vegetation detritus. The deposits of the ali ke character are traced to the North from the valley of the Aokhorak river too, as well as at the up-streams of the Khajazat sai. The apparent thickness of the described deposits in the basin of the Aokhorak river is valuated as to be within the linits of I000 meters.

The deposits of the Karnii-Norii stages sedimented in a comparatively small, protruding to the East by a narrow gulf marine basin. Its nearness from the shore and from the sources of removal essentially influenced the character of sediments, especially during the initial stages of the sedimentation, which are characterized by the accumulation of more coarse-grained material in general (conglomerates, sandstones). The tuffogeneous rocks (tuffogeneous sandstones, tuffites) are rarely met and are apparently the products of destruction of more old (probably of the Middle Triassic) lavae. Volcanic activity for the Karnii-Norii ages is not characteristic, though in a number of places the thin locally distributed lavae of andesitic composition were marked.

The accumulation of coal for the Karnii-Norii atages is also not characteristic, The thin hard-coal beds are marked only at the upper parts of the section on an extreamly limited areas. They had been accumulating apparently near the shore line, as for example in the valley of the Rafak river, near the village of Doshi. Hard coal in the form of thin (from 0,0I up to 0,35 m.) of rare lens-like interbeds is observed among argillites, aleurolites and sandstones, which are often cross-bedded. The accumulation of the initial material apparently took place in the process of the alluvial delta forming, which was periodically now dryed out, now swamped, now submerged by a sea. Coals apparently have a mixed autochthonous-allochthonous origin, to which testify the absence of complete remains of plants as well as lens-like character of beds and considerable contamination of them by rock's interbeds, the absense of the soil rocks with the typical for it root systems of plants.

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The R e t Stage.

The formations of the Ret stage among the deposits of the Triassic system have a wide distribution, involving an area of nearly 300 sq.km. They had been ascertaained in the following regions: in the southern-central one (the valleys of the Amir-Omad, Wodu, Turmush, etc. rivers), in the northern - central one (near Pul-i-Khumri), in the North-West of the investigated territory (the region of Chikhil-Dukhtaran village) and in the East (in the region of the Nakhrin village as well as at the interfluve area of the Chal-Namakab-Farkhar rivers).

The deposits of the Ret stage are lithologically quite different, though the main inportance among the rocks have effusive formations. For example in the Southern-central regions - it is a stratum with the thickness being nearly 2000 m., composed by effusives, which are dissected into the Ishpushtin and the Turmush series; in the northern-central region - the effusive-sedimentary-terrigeneous stratum with the thickness of nearly 350 m., singled out under the demomination of the Pul-i-Khumrin series; in the North-West they are represented by a terrigeneous stratum the thickness of which being nearly I500 m., singled out as Cheldukhtaran series with fresh-watered fauna (or with salty-watered one); and at last in the East and in the North-East the Ret stage is represented by comparetively thin (not more than 500 m.) stratum of effusives of mixed composition.

Below the successive description of the singled out stratigraphical subdivisions of the Ret stage is given.

The I s h p u s h t i n series

The Ishpushtin series deposits are developed on a limited area at the left bank of the Surkhab river, representing by themselves two rapproched outcrops. One of them, located at the interfluve area of the Amir-Omad (Istoma) and the Wodu rivers has the outlines of a strip, lolongated in sublatitudinal direction, with the extent of nearly 6-7 km., the width being from 0,3 up to I,0 km. From the North the deposits of the Ishpushtin series at the extent of 6-7 km. by a normal stratigraphical contact are overlapped by the rocks of the abovelying Turmush series, to the West - they are transgressively overlapped by the deposits of the Lower -Middle Jurassic age. From the North the rocks' strip of the Ishpushtin series is limited on the whole extent by a zone of tectonic fracture and only in the East near the base of the left slope of the Surkhab river at the extent of I-I,5 km. a normal stratigraphical contact of them with the un-

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derlying deposits of the Karnii-Norii stages could be observed.

The second outcrop located to the North-East at the interfluve area of the Wodu and Turmush rivers having isometric outlines is limited mainly by tectonic lines and by Quaternary deposits.

Total area involved by the outcrops of the Ishpushtin series amounts not more than 25 sq.km.

The Ishpushtin series is composed in considerable degree by volcanogeneous rocks of medium and less of acid composition: by lavae, agglomeration lavae, lavabrecciae, welded tuffs and by tuffs of augite-porphyries quartzy porphyries (dacites), subbordinated lavae, welded tuffs of quartzy porpyries and by the rocks of mixed composition; more subbordinated are tuffites tuffosandstones, aleurolites, argillites and coaly argillites: very seldom thin lenses (not more than 5-8 cm.) of hard coal are met.

Lava of augite andesite is of dark green colour, also of greenish-brown of different tints, being of massive structure, sometimes with apparent to the naked eye impegnations of quartz. Under a microscope the rock is composed by impregnations and by the ground mass. Impregnations (up to 30-60%) with the size of 0,5-I,5 rarely up to 3 mm. are composed by plagioclase (from andesine to labradorite) and augite). Plagioclases are often replaced by sericite and chlorite, rarely by epidote; augite - by bright-green serpentine, pale-green chlorite, calcite and iddigstite-like mineral. Singular melted graines of quartz are met. The ground mass is fine-grained up to very fine-grained, is composed by laths of plagioclase small grains of augite and ore mineral; it is usually intensively replaced by chlorite, sericite, epidote and calcite. The latter sometimes forms nests. Structure is porphyritic, transiting into porphyry.

Agglomeration lavae, lavabrecciae and welded tuffs of augite andesine are of grey-green, green-brown, black-green-brown, rocks of massive composition with spotty colour. In these rocks fragments with often smooth angles of the same lava with the size of more than ten cm. (agglomerations or within the limits from 0,3 up to I0 cm. (lavabrecciae) or smaller than 0,3 cm. (welded tuffs). Most often the mixed according to the difference in the size rocks sush as agglomeration-tuffs, agglomeration-tuffobrecciae and so on are met. Among fragments lapilli and bombs are often met.

Under a microscope these rocks differe from the pure lavae by the presence of fragments, enclosed into fine-grained, sometimes into glassy quart-feldspatic mass. The ground mass amounts up to 20% of the rock. The rock has litoclastic, crystalloclastic and vitrocrystalline texture.

Lavae of quartzy porphyrites are of green-grey with pink sections, pink-grey up to pink colour massive rocks with well noticeble impregnations of transparent quartz with the size of impregnations up to 2-3 mm. and sometimes of pink feldspar. Under a microscope the rock is composed by impregnations and by the ground mass. Impregnations with the size of from 0,5 up to 3 mm. are composed by acid andesine and quartz. Impregnations of quartz are often melted and corroded; plagioclase is slightly sericitizated and carbonatizated. The ground mass is poorly crystallized and is composed by small grains of quartz, feldspars and small fragments of glass often crystallized in small spherolites. Carbonatization is observed here..Structure of the rocks is porphyritic.

Lavabrecciae and welded tuffs of quartzy porphyrites - are grey, green-grey with pink spots, grey-pink spoty-coloured rocks of massive

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or of noticeble coarse-clastic structure. In the rock fragments of lava of the same composition with smooth angles could be seen, rarely met lipilli and volcanic bombs. The size of fragments ranges from 0,3 up to I0 cm. (lavabrecciae) in other cases it does not exceed 0,3 cm. (welded tuffs). Under a microscope the fragmental structure of the rock is quite clearly pronounced; besides fragments of lava in the ground mass of the rock there are many fragments of quartz, feldspars. Structure of the rock is lithoclastic, crystalloclastic, litovitrocrystalloclastic.

Tuffs of a mixed composition in outward appearence do not differ from the tuffs of andesites or from tuffs of quartzy porphyrites. Under a microscope side by side with acid andesine and augite, usually replaced by serpentine there are many fragments of quartz crystalls and solid fragments of lava of quartzy porphyrites met.

Tuffites are of grey, greenish-grey colour, of massive structure rocks; under a microscope side by side with medium and poorly rounded grains of quartz, feldspars, schists and leafs of muscovite the rock contain up to 60% of did not rounde at all graines of quartz and feldspars. Cement of the rock is siliceous-chloritic, strongly carbonaceous, of porous rarely of basal type.

Tuffo-sandstones are grey, greenish-grey rocks of massive structure, sometimes unclearly bedded. In outward appearence the rocks are less different from tuffites. Under a microscope they are composed by medium-and poorly rounded graines of quartz, feldspars, schists, quartzite-like rocks. Besides it in them there is up to I5-20% of pyroclastic material; sharp-angular fragments of quartz, feldspars and of fine-grained ground mass of effusive rocks. Cement is interstitial, in some sections is poikilitic, siliceous-chloritic or carbonaceous one. Texture is psammitic and crystalloclastic.

Sandstones polymictic are of grey, yellowish-grey colour, fine-and medium-grained, dense, of massive structure, as well as unclearly bedded one. Under a microscope they are composed by medium and poorly rounded grains of quartz (up to 30%), alterated feldspar (I0-I5%), fragments of schists (5%), quartzite-like rock (5 %), black chalcedony (3%) and flakes of muscovite (5%), as well as by cement (35-40%%). Cement is quartz-sericite carbonaceous, sometimes with chlorite and nests of calcite, of interstitial type, rarely of contact and more rare of basal type. Structure of the rocks is psammitic; texture is irregular-grained.

Aleurolites polymictic are of grey, brownish-grey colour, dense uncle arly bedded or thin-bedded. By the composition do not differ from the described above sandstones. Often contain small chared vegetational detritus.

Argillites are grey, dark-grey up to black colour rocks, often micaceous. When weathered they provide thinplaty or fine-fragmental up to "pencil" rock waste. Under a microscope they composed by homogeneous mass which has in the polarized light a spotty or wavy extinction. The rock dontains up to I0% of small aleuritic material, slightly rounded, sharp-angular, composed mainly byquartz, less by alterated feldspars and flakes of mica. Sometimes grains of carbonate and ore mineral are met. Coaly varieties are coloured in brown, rarely in dark-brown colour, and contain concretions of black coaly matter. Carbonatizated fragments of plants are rarely met. Texture of the rocks is pelitic with transitions to aleurolitic one.

The rocks of the Ishpushtin series in the section differ by a great unstability of the thickness and by lens-like occurrence, in consequence of what only a general characteristic of their sequence, ascertained on the grounds of the whole area of their distribution study, could be given here.

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The contact with the underlying Karnii-Norii deposits observed at a very limited extent is sharp. Greenish-grey fragmental argillites and aleurolites without apparent unconformity are replaced by lavae of andesitic composition or by their pyroclastic derivates. But in one of the cases among the tuffo-sandstones and tuffs lying on the base of the Ishpushtin series,pebbles of the underlying Karnii-Norii argillites had been found what testifyes to a probable,apparently local break of sedimentation.

S.Tromp (I954) having sigled out the Upper series of Doab had also indicated on the concordant its occurrence on the lower one,probably corresponding to some part of the Karnii-Norii stages. As an indirect evidence of the washout between the Karnii-Norii and Ishpushtin (Ret) deposits could serve the gradual thinning and then a complete falling out of the Karnii-Norii deposits as tracing them to the East and North-East,while the Ret formations are traced in this direction continuously in general up to the eastern boundaries of the investigated territory.

The most complete section of the Ishpushtin series could be observed in the region of the Wodu and Turmush river valleys (fig.26,dr.25). Here at the base of the section lie either lavae and agglomeration lavae of acid composition,or light-grey,greenish tuffs and tuffo-sandstones,well apparent at the mouth of the Turmush sai. Sometimes they contain semi-rounded fragments of greenish argillites,aleurolites and other rocks. In tuffo-sandstones and sandstones one can see coarse bedding,at some places - cross bedding. This basal bench reaches the thickness of 80-I00 m.

Above by the section the interstratification of pinkish-green,pink, green-grey or greenish sandy argillites,aleurolites with tuffogeneous material,tuffites and tuffogeneous sandstones contaning seams (up to I,0m.) of black sandy coaly argillite with vegetation detritus and rarely with thin lenses of hard coal could be observed. At the basement of this effusive-terrigeneous bench among the coaly sandy argillites at the mouth of the Wodu sai the following remains of flora had been discovered: Dictyophyllum sp.,Podozamites sp.,Yuccites sp., The thickness of this part of the section is apparently amounts not less than 250-300 m,,however it does not remain even approximately the same in the adjacent sections for the pinching out of ones benches and appearing of another ones. For all this at the upper part of the section the replacement of sedimentary rocks by volcanogeneous could be observed,among which often and often appear lavae of medium and basic composition.

The upper part of the series which amounts 600-700 m. in the thickness,is represented by exclusively volcanogeneous rocks. Lavae,agglomeration lavae,lavabrecciae and welded tuffs of andesitic porphyrites being

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from grey-green up to dark-green colour in the pyroclastic varieties and from green-grey up to lilac-black in lavae, form continuous alternations of lens-like benches with the thickness being from first up to 30-40 m.

Besides lavae of medium and basic composition here sometimes met beds of lavae and pyroclasts of acid composition.

The deposits of the Ishpushtin series are often cut by dikes and by small stocks of quartzy porphyries and rarely of andesitic porphyries. Both the first and the second ones are apparently the fillings of incurrent canals of a fissured type by which in the first case the acid lavae of the above-lying Turmush series had been erupted and in the second one--the lavae composing the Ishpushtin series.

Total thickness of the Ishpushtin series valuated by several intersections does not exceed I000 m.

The age of the Ishpushtin series is dated by the finds of fossil flora which has been described above. According to the conclusion of T.A.Sikstel and N.M.Loseva who determined this flora the latter had development during late Triassic time.

The described sedimentary-effusive formations of the Ishpushtin series are apparently corresponding to the lower part of the Doab series, singled out in the region of the Doabi-Mekhzarin village by S.Tromp(I954) from the series Doab of G.Gaiden(I9II). S.Tromp to the upper series of Doab relates different volcanogeneous rocks (basalts, porphyrites, riolites and their tuffs, andesites, quartzy porphyries, etc.) with total thickness being up to I000 m. At the upper parts of this series R.Furon(I926, I94I) had discovered the Ret fossils: Baiera simmondsi Shivl. muensteri Presse Thus, the collections of R, Furon and our finds from the basement of the volcanogeneous part of the section confirm the Ret stage of the Ishpushtin series in general.

&The T u r m u s h series

The deposits of the Turmush series are distributed at the same areas as the Ishpushtin one in general, but have less area of outcrops, amounting 6-7 sq.km. only. The most considerable outcrop of the Turmush series rocks is observed at the interfluve area of the Amir-Omad and Wodu river It has been continuously traced for more than 6 km. From the South these deposits are limited by a stratigraphical contact with the underlying rocks of the Ishpushtin series, from the North - by a transgressive contact with the deposits of the Lower-Middle Jurassic. The Turmush series is characterized by an exclusive development of volcanogeneous rocks. Among them the rocks of acid and less of medium composition are developed lavae, agglomeration lavae, lavabrecciae and welded tuffs of quartzy

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porphyrites(dacites). The rocks of basic composition are marked as exclusive ones only in the form of lava covers and also in the form of cutting bodies - dikes and stocks. Basic rocks are represented by diabases and their tuffs. Only in one case at the very upper part of the section a seam of diabasic lava with the thickness being up to I5 m. transitioning along the strike into welded lavae and then pinching out,was marked It is possible that the limited distribution of the basic rocks at the upper parts of the Turmush series is connected with a denudation-erosional processes which took place during the Lower Jurassic epoch and lead to partly destruction of them.

Sedimentary rocks in the section of the Turmush series are exclusively rare. They are represented by tuffo-sandstones and clayey tuffogeneous sandstones with vegetative detritus mainly.

Lava of quartzy porphyry is of greenish-pink,grey-pink,rarely of grey colour,of massive,rarely of banded structure with porphyritic texture. It is composed by impregnations and by the ground mass. Impregnations compose up to 40% of the whole volume of the rock and being represented by quartz and acid plagioclase(from albite up to andesine). The size of impregnations is usually 2-3,rarely up to 7 mm. In impregnations the dark-coloured mineral is completely replaced by chlorite(probably amphibole).Such replacement is very often here. Amphibole - is often with an apacite-like rim. Sometimes in the impregnations common potassium feldspar is marked. The ground mass is composed by quartz,plagioclase and by common potassium feldspar,which sometimes forms spherolitic growths and micrographic intergrowths in quartz. Biotite,ore mineral and sphene are rarely met. Out from secondary minerals there are chlorite,sericite,spidote,zeolite,leucoxene,calcite,hydrooxides of ferrum met.

Agglomeration lavae,lavabrecciae and welded tuffs of quartzy porphyries are the rocks of green-pink,grey and brown colours with spoty colouration being of massive structure. Fragments of lava being now sharpangular,now with smooth angles,rarely lapilli and bombs,fused into the ground mass,could be seen. The inumerated varieties of the rocks differ only for the size of the fragmental material of lava. Under a microscope the rock is composed by sharpangular fragments of quartz,plagioclase, crystalline glass,microfelsite with the size of fragments up to 3-4 cm., cemented by microcrystalline mass being chloritizated and calcitizated. Structure of the rock is psammitic,lithocrystalloclastic.

Quartzy porphyries(dacites) are green-grey,pink-grey up to pink rocks with massive structure and porphyritic texture,identical to the described above in the section "Ishpushtin series".

The rocks of the Turmush series,as well as of the Ishpushtin one in the section differ by unpersistence both by the dip and along the strike.

The section of the Turmush series in the region of the Wodu river valley(fig.26,dr.25) usually begins with the bed of pink agglomeration lavae of quartzy porphyry,transitioning into lavabrecciae and welded tuffs,the thickness of which being up to 30 m. These lavae concordantly occur on green and greenish-grey effusives of medium composition and

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belong to the Ishpushtin series. Contact is usually sharp. Above by the section there is nearly 30 m. of welded tuffs, composed by fragments of lava being in a size up to 5-8 mm. and of grey, pinkish and dark-brown colour and by impregnations, rarely by fragments of quartz, the size of which being up to 2-3, rarely up to 8 mm. On the welded tuffs grey-pink, pink, rarely yellowish-red, sometimes grey massive lavae of quartzy porphyry with the thickness being from 20 up to 50 m. are occurring. Here also small lenses of tuffogeneous brown-grey sandstone (up to I-I.5m.) sometimes with vegetative detritus, occurring on quartzy porphyries and being covered by tuffs and welded tuffs, could be observed. Alternation of the volcanogeneous rocks of acid and rarely of medium composition(dacites) is traced further above too with different variation of thicknesses of separate benches, however being within the limits of the first hundred of meters.

At the upper part of the series rare lenses of basic composition (diabases) lavae with the thickness being up to 20-30 m., transitioning along the strike into lavabrecciae and tuffslavae appear. On these lavae and welded tuffs and at the places where they are absent- on the lavae and welded tuffs of acid and medium composition the parycoloured remained crust of weathering with the thickness being up to 20 m., overlapped with unconformity by terrigeneous deposits of the Lower Jurassic(the Saihan series) could be observed.

The deposits of the Turmush series are cut by rare dikes and stocks of acid composition(quartzy porphyries, granite-porphyries), rarely of basic composition (diabases). The formations of the Turmush series are besides it cut by small intrusions of medium composition- quartzy porphyrites (the valleys of the Wodu and Turmush rivers, near their mouths) being of orbicular or of isometric form and an area at the outcrop from 2 up to 4 sq.km. On these small intrusions, in the valley of the Wodu river the Per Jurassic residual crust of weathering is observed.

The age of the Turmush series deposits is determined by the situation of it in the section: it occurs stratigraphically above the Ishpushtin series with the remains of the Ret flora and at its lower and middle parts is transgressively overlapped by the deposits of the Middle Lias.

Taking into consideration the fact that the Turmush series is dislocated and is cut by intrusions , which by the Middle Lias had already been exposed by an erosion and on which the residual crust of weathering with the thickness up to 20 m. was already been formed, it appears to be quite probable to suppose its (the Turmush series) Late Triassic age, which apparently did not involve the whole Ret.

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The Pul-i-Khumri series

The deposits of the Pul-i-Khumri series for the first time had been described in the region of Pul-i-Khumri town by V.K.Melekhin(Makhnev A.M Shakhijanov Ju.S. and others,I962). Later they were studied by A.K.Dertev (G.N.Khatiskatsi,A.K.Dertev and others,I963) and then in I964 by us.

The Pul-i-Khumri series is exclusively outcropping in the region of Pul-i-Khumri town,5 km.to the East from it,in the valleys of the Sanhach and Elevatornaya rivers. The indication of A.K.Dertev on the fact that the describing deposits are also developed in the North-East in the region of the Chal pass does not correspond to the facts as among the effusives the flora of the Lower-Jurassic age had been collected. Lithologically the effusive formations near the pass of Chal are indeed very much alike to the deposits of the Pul-i-Khumri series and could have been considered as the latter.

The area of the Pul-i-Khumri series deposits'outcrops in the region of Pul-i-Khumri town amounts not more than 5 sq.km. Inspite of such an inconsiderable area the sections described here in different places differ one from another both lithologically and by their thickness,though their general effusive-sedimentary character remains the same.

The Pul-i-Khumri series is composed by conglomerates being pebbly-boulder ones and by coarse gravels,gravellites,sandstones and aleurolites,being often tuffogeneous,also by argillites,tuffs of medium composition. The predominant rocks in the section are gravellites,sandstones, aleurolites.

Conglomerates - pebbly,rarely rubby composed by poorly rounded fragments of white quartz,micaceous and quartzy-micaceous schists,quartzite-like sandstones and aleurolites,volcanic rocks. Volcanic bombs of medium composition(quartzy porphyries) are often there. The size of fragments ranges from small up to medium-pebbly,sometimes boulders with the size of from 0,3 up to 0,5 m. are met. Cement of interstitial type being sandy quartzy-clayey-sericitic with tuffogeneous material.The colour of conglomerates is green-brown,brown,often rusty-brown at the expence of ferrugi nization. In cement chared vegetative remaims are often met.

Gravellites - fine-medium and coarse-grained,composed by poorly and medium rounded fragments of quartz and feldspars,effusive rocks,hornfels rarely fragments of metamorphic rocks,flakes of mica.Cement of interstitial type being tuffogeneous-sandy quartzy-clay-sericitic of different density. The colour of gravellites is different: in arcose varieties it is pink,greenish-pink, in polimictic ones - grey-green,brownish-green.

Sandstones are fine- and medium grained,inequigranular composed by medium-rounded grains of quartz (I5-20%),feldspars (40-50%),mica (I0-I8%),fragments of siliceous rocks and other rocks(up to I0%). Cement of interstitial type being clayey-sericite-siliceous,sometimes with an admixture of carbonaceous material of different density. In sandstones the fragments of silicifcated wood,small vegetative detritus,soot selvages, small pebbles of quartz and hornfel,small lenses of gravellite,are met. In separate interbeds,due to sorting of material a cross beddin of a ri-

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ver type(angles reach 35-38°) could be seen. The colour of sandstones is different,often being reddish-brown,greenish-grey,pinkish-grey,almost white.

Sandstones tuffogeneous have all the peculiarities of the described above sandstones,but in contrast to them they contain up to I0-I5% of pyroclastic material in the fragmental part and approximately the same quantity in cement in the form of fine ash. The latter sometimes accumulates in the form of lens-like accumulations,stressing the lamination of the rock.

Tuffites are usually coarse and medium-grained,composed by poorly and medium-rounded grains of feldspars(microcline-45%),quartz(up to I5%) fragments of effusive rocks(up to 40%),small flakes of mica. Cement is of interstitial type,sometimes it is basal,aleuritic,ashy-clayey,ashy. In the latter case by it thin flakes of sericite are developed. Tuffites are usually unbeded or unclearly bedded being of greenish-grey or grey colour often with rusty-brown tints and strips. They sometimes contain fragments of mineralized wood and small vegetative detritus.

Tuff of quartzy porphyrite has a massive structure,divided into separate niggerheads with the dimentions of from walnut up to the size of fist. It contains inclusions of small volcanic bombs (3-5 cm.). At some places tuff is apparently predominantly composed by ashy material and has dense homogeneous structure. The colour of the rocks is red,cherry-grey,brown-grey. Under a microscope the rock is composed by fragment (up to 50%) and fine-crystalline(ash+ glass) basal cement. The fragments are angular,semiangular,composed by quartzy porphyrite,quartz,plagioclase (No.30-40),with the size of them being up to 2.5mm.,and by more small sharpangular or slightly melded together fragments of glass. By glass fine-crystalline calcite,hydrooxides of ferrum and cement are often developed. The rock has a psammitic-aleurite vitolitoclastic and massive texture.

Aleurolites polymictic of dense structure,rarely thin-platy and even foliated with more considerable admixture of mica and vegetative detritus by planes of foliation. In the dense varieties a thin cross bedding conditioned by sorting of a material is often could be seen. The colour of the rock is grey-green,brownish-grey,grey. Under a microscope the rock is composed by medium-rounded grains of quartz(up to 20%),feldspars (up to 50%),usually strongly alterated ,mica (up to I0%),fragments of different rocks (up to I5%),mica,ore minerals and very often grains of zircone (up to 2%). Cement is quartzy-sericite-clayey of an interstitial type or basal one.

Argillites are of greenish-grey,brownish-grey colour,dense with fine-fragmental or "pencil" jointing,slightly micaceous,often with admixture of aleuritic and sandy material. At some places a ferruginization in the form of small spots or lenses could be observed.

The section of the Pul-i-Khumri series deposits had been studied by us at the down-stream of the Sanhach river,at the distance of 5 km. to the East from the Pul-i-Khumri town(fig.27,dr.27). Here on the metamorphosed rocks of the Lower-Middle Paleozoic age with angular unconformity the following rocks are occurring:

I. Conglomerate inequipebbly of green-brown,mainly medium-and coarse-pebbly with boulders being in size up to 0,3-0,5 m. and with rare volcanic bombs,with lenses of small-pebbly conglomerate and gravellite,especially at the upper part of the bench..... 6,5 m.

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2. Interstratification of gravellites being of pink and brownish-pink colour, arkose ones being of green colour and brownish-green polymictic ones (the thickness of the beds being I-5 m.) and of red-brown and green-grey sandstones being medium-and coarse-grained, sometimes clayey, with the thickness being I-3 m., sometimes containing horizons of pebbles; at the upper part of the section-there are rare interbeds with the thickness being up to 0.2 m. of grey, greenish-grey aleurolites.... ..... I6I.0 m.

3. Tuff of quartzy porphyrite dense of brownish-red colour with impregnations of quartz and feldspars..... 27.0 m.

4. Interstratification of tuffs being of cherry-grey colour, at some placas being ferruginized and also of reddish-brown colour, with apparent to a naked eye impregnations of quartz and of pink feldspar and of fine-and medium-grained brown sandstones. Tuffs are the predominant..... 25.0 m.

5. Interstratification of brownish-grey gravellites and grey aleurolites (interbeds being in thickness I-I.5 m.). Above there is a bed of grey ashy tuff with the thickness I m..... 53.7 m.

6. Frequent interstratification (interbeds being in the thickness up to I-I.5 m.) of brown, grey, pinkish-grey gravellites (their quantity is decreasing at the upper parts of the section), sandstones and aleurolites..... 35.7 m.

7. Interstratification of greenish-grey and brownish-grey aleurolites and argillites; rare interbeds of sandstones 34.0 m.

8. Tuffo-sandstone of greenish-brown colour of breccia-like structure, at the upper part of the section it is transitioning into grey, violet-grey micaceous aleurolite. At the lower part of the bed the remains of Thaumatopteris sp., Equisetites sp. flora are found..2.5m.

Total thickness of the Pul-i-Khumri series 347.0 m.

On the tuffo-sandstones and aleurolites of the bed No.7 with unclearly pronounced fracture and apparently with non-considerable crust of weathering (violet tints at the upper parts) lie sandstones being of brownish-grey colour (nearly 24 m.), directly above which in argillites and aleurolites the " aggerellic complex" of anther dust and of sporea had benn ascertained which testifyes according to the conclusion of T.Kuznetsova to the very lower horizons of the Lower Jurassic. At the same time the remains of flora from the bed No.7 of the described above section according to the conclusion of T.A.Sikstel and N.M.Loseva indicate to the Late Triassic.

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The section described by A.K.Dertev (G.N.Khatiskatsi,A.K.Dertev and others,I963) approximately in the same region under the denomination of " northern" differs from the adduced by us section for more great content of tuffogeneous rocks at its upper part only. The thickness of"thenorthern" section described by A.K.Dertev is 3I0 m. Besides "the northern" section by A.K.Dertev here adduced " the southern " one also, which in contrast to the first section is built over by " the bench III" mainly composed by sandstones and gravellites,interstratificating with argillite-like clayes and rare lenses of tuffs,the total thickness of which being I90 m. A.K.Dertev does not give any proofs on the Triassic age of this bench. According to our data this part of the section one should relate to the lower parts of the Lower Jurassic age,as it lithologically alike to that part of the Lower Jurassic section in the valley of the Dudkash and Sanhach rivers,from which by T,Kuznetsova "the aggerelic complex" of anther dust and sporae had been determined. At this variant the thickness of the Triassic deposits in "the southern section" will amount 305 m. and it will little differ from "the northern" one.

Approximately 4 km. to the South from the described by us section in the valley of the Elevatornaya river the section in general alike to the before given for the valley of the Sanhach river could be observed. It is distinctive for the heightened coal-bearing. Already in the lower its coarse-fragmental part the lenses of black soot coals with the thickness up to O.IO m. are marked. Interbeds of coal being of non-considerable thickness could be also observed at the upper part of the section,where they occur among the interstratificating yellowish-green tuffogeneous sandstones,gravellites and brownish-grey argillites.The thickness of the Triassic deposits in this section according to the materials of V.K.Melekhin(A.M.Makhnev,Yu.S.Shakhijanov and others,I962) approximately amounts 360 m.

Thus,the thickness of the Pul-i-Khumri series deposits in the region of Pul-i-Khumri town ranges from 305 up to 360 m. From the collection of fossil flora of A.K.Dertev,collected from the middle and upper parts of"the southern sections""of the Elevatornaya river valley T.A.Sikstel and N.M.Loseva had determined the following fossils: Glathopteris sp., Thaumatopteris sp.,Equisetites sp. According to their conclusion the first two fossils even determined as genus testify to the Late Triassic age of the deposits. They are widely distributed in the Norii-Ret deposits of the Gissara,what had served as a basement for G.N.Khatiskatsi and A.K.Dertev(I963)for the relation of these deposits to the Norii-Ret stages.

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Correlating the considered sections of the Upper Triassic deposits one can notice that the volcanogeneous rocks are widely developed among the Ret deposits,while the Karnii-Norii ones are usually represented by sandy-clay facies with poor marine fauna. Taking into consideration this fact we consider it to be more exact the relation the Pul-i-Khumri series to the Ret stage;possibly it should be correlated with the Ishpushtin series,described in the region of the Namakab river. In favour of such correlation speaks the near composition of vocanogeneous rocks,composing the two series also.

The accumulation of the Pul-i-Khumrin series rocks took place in continental conditions,in intermontan erosion-tectonic depression:they have a volcanic and alluvial genesis. By this fact the lithological irfegularity of some seams and benches of the section,underwent a facial replacement at a very short distances is explained.

The accumulation of coal is not characteristic for the Pul-i-Kumrin series and it was apparently manifested sporadically on a very limited areas of the depresssion underwent a swamping. Coals apparently have an autochtone-allochthone origin as with the absence of a clearly pronounced soil,contamination of coal by a rock material as well as by irregular thickness of coaly lenses the presence of root systems(in one case) and often of delicate parts of vegetation is marked.

The C h e l d u k h t a r a n series

The Triassic deposits of the Chakhil-Dukhtaran village region(in 4-5 km. to the North-West from the hard-coal deposits of Shabashek) are singled by us into the Cheldukhtaran series,the age of which we consider conditionally to be the Upper Triassic one. The area of the series outcrop in the region of the Chikhil-Dukhtaran village amounts 5.5-6.0 sq,km. At another places of the investigated territory analogical deposits are not known.

The Cheldukhtaran series without a noticeble break and unconformity is overlapped by the coal-bearing deposits of the Regbulak series (the Lower Jurassic) from which it is conditionally singled out by the seam of sandstones with marine(?) fauna of the Triassic age. The rocks underlying the described series do not outcrop in the investigated region. Total apparent thickness of the Cheldukhtaran series amounts more than I475 m.

The Cheldukhtarin series is mainly composed by coarse-terrigeneous rocks:aleurolites,sandstones,argillites,coaly argillites; in subordinate quantity there are seams of sandy limestones,concretional interbeds and rarely - bun-shaped concretions of siderite,seams and thin lenses of hard

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coal, characteristic mainly for the upper part of the section met.

By the lithological features the Cheldukhtaran series is subdivided into three parts: lower, middle and upper ones.

The lower part of the Cheldukhtaran series is characterized by sharp predominance of sandstones and aleurolites (up to 90%) in the section which compose seams and benches with the thickness of the latters from I0 up to 30 rarely -50 m. The benches are usually represented by interstratification of beds of sandstones and aleurolites, rarely of argillites and thin concretional interbeds of siderite the thickness of which being from 0.02 up to 0.20 m. Separate rare seams of argillites often being aleuritic in their thickness do not exceed I-3 m. The general colour of the lower part of the series is grey-green, grey more light than of the above lying "middle" part of the series. The remains of fauna in contrast to the middle and upper parts of the series had not been found here. Quite often vegetative remains in a form of detritus and imprints of stems belonging almost exclusively to equisetums are met here.

The rocks of this part of the series are not carbonaceous (they contain films of secondary calcite by fissures only)

The most representative section of the lower part of the Cheldukhtaran series is observed in the core of the same by name anticline, near the village of Chikhil-Dukhtaran (fig.28, dr.20). Here the following rocks are exposed (from the basement):

I. Sandstone grey, light-grey medium-grained polymictiv of massive structure, at some places unclearly bedded, cross-bedded (angles up to 25°). Lamination has a parallel character and is stressed by ferruginization, the apparent thickness is ..... 50 m.

2. Sandstone of grey-green colour with rusty spots, polymictic, aleuritic, thin-platy with rare interbeds of dark-grey argillite... 30 m.

3. Interstratification of sandstones being of grey and grey-green colour, finegrained and of platy aleurolites and dark-grey argillites. Sandstones contain undetermined vegetative remains ..... 9.5 m.

4. Interstratification of sandstones of grey-green colour being finegrained, thin-platy and of dark-grey aleuritic argillites. Above there is a 4 m. thick seam of grey medium-grained polymictiv sandstone. Concretions and concretional interbeds of siderite with the thickness of up to 0.I m., remains of equisetums are often met ..... 54,0 m.

5. Interstratification of sandstones of grey-green colour being finegrained thin-platy and of aleurolites of the same colour. There are rare interbeds of dark-grey argillites. Sometimes concretional interbeds of clayey siderite with the thickness up to 0.88m. are met.....3I.0 m.

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6. Interstratification of sandstones of grey-green colour, being medium and fine-grained, aleuritic, polymictic, thin-platy and of aleurolites. There are rare interbeds of dark-grey argillites. Concretional interbeds of clayey siderite with the thickness of up to 0.05 m. are often met.. 25.0m

7. Sandstone of grey-green colour, being medium-grained, polymictic, massiv-bedded, at some places thin-bedded and thin-platy with imprints of equisetums. At the upper part nearly 4 m. and at the lower part- 2 m. of dark-grey argillites..... 26,0 m.

8. Sandstone of green-grey colour, being medium-grained, polymictic with fine coaly detritus, the structure now massive, now bedded thin-platy.... ..... 32.0 m.

Total apparent thickness of "the lower part" of the Cheldukhtaran series is ..... 270.0 m.

As it could be seen from the given above description the section of the lower part of the Cheldukhtaran series is distinctive for more great monotony and is mainly composed by sandstones and less by aleurolites. The mentioned before sharp cross bedding is more likely related to the type, characteristic for a bottom current. It is possible that the described section is characterizing a submarine paleodelta being considerably remote from its head part.

The middle part of the Cheldukhtaran series in comparison with the lower one is characterized by a considerable presence of argillites and by considerable amount of aleurolites, by the presence of calcareous varieties of sandstones and rarely of sandy limestones often containing calcitizated fragments and intact shells of undetermined pelecipodae. A considerable quantity of vegetative detritus, fragments of mineralized wood, rarely poorly preserved delicate remains of vegetation is marked. The colour of the whole stratum becomes grey-dirty, grey-green, dark-green-grey, sometimes with brownish tint.

The section of the middle part of the Cheldukhtaran series is observed at the southern wing of the Cheldukhtaran anticline (fig.28, dr.20). It has the following structure (from the basement):

I. Interstratification of dark-grey argillites, sandstones of greenish-grey, polymictic, thin-bedded, thin-platy being aleuritic and of aleurolites. There are concretions and concretional interbeds of siderite marked At the middle part there is a seam of sandstones with broken shells..82.0m

2. Sandstones of grey-green colour being medium- and fine-grained, polymictic, massive-bedded, slightly calcareous with broken shells; at the besement there is a seam of argillite..... 33.0 m.

3. Interstratification of grey, dark-grey argillites, sandstones being dirty green-grey polymictic, thin-platy, thin-bedded and of aleurolites; there are also concretional interbeds of siderite, imprints of equisetums met..... 20.0 m.

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4. Sandstone of grey-green colour being medium-grained,polymictic, calcareous, it contains concretional interbeds of siderites,there is often ferruginization in a form of strips and spots observed. Separate interbeds and lenses of sandstone contain broken,rarely intact shells; imprints of equisetums are often met here ..... 35.0 m.

5. The same rocks as in the bed "3" ..... 80.0 m.

6. Interstratification of aleurolites being of green-grey colour and of sandstones being of dirty-green-grey colour,polymictic,platy;at the lower parts of the section there are interbeds of argillites marked;at the middle one - two horizons of sandstones with the thickness of 2.5 m. being calcareous with remains of shells..... 63.0 m.

7. Sandstone dirty-greenish-grey medium-grained,polymictic,calcareous massive-bedded..... 25.0 m.

8. Interstratification of dirty-green-grey aleurolites and sandstones being fine-grained,polymictic,platy;interbeds of calcareous sandstone with undetermined remains of shells..... 35.0 m.

9. Sandstone of dark-greenish-grey colour,medium-grained,polymictic with remains of shells ..... I5.0 m.

I0. Interstratification of dirty-greenish-grey aleurolites,sandstones being medium-and fine-grained,polymictic and platy; there are single seams of grey argillite marked;at the basement of the bed there is a seam of calcareous sandstone with the thickness of 3.5 m. with broken shells..... 94.9 m.

II. Sandstone light-grey medium-grained polymictic calcareous massive-bedded..... 35.0 m.

I2. Sandstone grey-green medium-grained polymictic calcareous with an interbed containing broken shells; at the lower and at the upper parts there are interbeds of argillite with the thickness up to I m. .. .. I9.5 m.

I3. Sandstones of dirty-grey-green,grey-reddish colour,medium-grained polymictic calcareous; they contain interbeds of strongly sandy yellowish brown limestone with broken calcitizated shells;there are many of vegetative remains;at the basement there is a bed of argillite 26.0 m.

I4. Thin interstratification of grey argillites and aleurolites..... ..... 5.5 m.

I5. Sandstones grey-reddish,grey-green being medium-grained polymictic calcareous with undetermined remains of shells (at the roof),they contain concretions of siderite ..... I7.0 m.

I6. Interstratification of aleurolites being of green-grey colour and of grey argillites ..... 8.0 m.

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I8. Interstratification of argillites being of dark-grey colour and aleurolites of grey-green colour;at the middle part there is a bed with the thickness being I.5 m. of calcareous sandstone with remains of shells at the lower part of the section argillites are the predominant.. I7.5 m

I9. Sandstones grey,grey-green medium-grained polymictic,rarely - coarse-grained,transforming into gravellites;they contain undetermined remains of shells ..... . 40.0 m.

20. Interstratification of sandstones being fine-grained,aleurolites and argillites being grey-, green-grey in colour,the thickness of beds is 0.5-I.5 m.;at the middle part of the section there is a seam with the thi ckness of I.5 m. of strongly sandy limestone with remains of shells and fragments of wood..... 20.0 m.

2I. Sandstones of grey,dark-grey colour being medium- and fine-grained polymictic with interbeds of green-grey aleurolites the thickness of which being up to 3.0 m.;at the middle part of the section there is a seam of calcareous aleurolite with calcitizated shells of pelecipodae.. 74.I m.

22. Aleurolite of dirty-grey-green colour with interbeds being in the thickness up to 0.8 m. of fine-grained sandstones;at the lower part - there are interbeds of argillites;rare remains of calcitizated shells of pelecipodae,imprints of equisetums..... I2.0 m.

Total thickness of "the middle part" of the Cheldukhtaran series is ..... 740.0 m.

In the given section the ratio of different varieties of the rocks is expreseed by the following figures: sandstones -60%,aleurolites-25%, argillites - I5%. For all this not less than 40% of all the rocks are represented by in this or in that degree calcareous varieties,beginning from slightly calcareous up to sandy limestones. Organic remains in the form of broken shells and rarely - of intact pelecipodae are usually completely replaced by dark-grey up to black calcite and could not be determined. The described deposits are apparently also related to those of a delta type,as they differ for irregular composition of separate beds and intact benches,as well as for frequent pinching out,etc.

The upper part of the Cheldukhtaran series differs from the below lying " middle part" by still more quantity of seams of argillites,by the presence of coaly argillites and rare thin seams and lenses of hard coal. Here also the calcareous sandstones are still to be met,but the remains of pelecipodic fauna in them are extreamly rare. In aleurolites and argillites a vegetative detritus and remains of equiseptums,apparently

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stable in the process of transportation are often met,but there are no at all of delicate parts of plants. The colour of the stratum is dirty-grey-green being more dark than of the below-lying part of the section.

The section of "the upper part" of the Cheldukhtaran series(fig.28 dr.20) is observed at the same places as the section of "the middle"part at its continuation(from the bottom):

I. Sandstones of light-grey,grey-green colour,being medium-and fine-grained polymictic,with rare interbeds of aleurolites..... 39.8 m.

2. Interstratification of argillites being of dark-grey colour,aleurolites being clayey and sandstones beng light-grey medium-grained,polymictic,slightly calcareous with imprints of equiseptums. There is an interbed of hard coal with the thickness of 0.I5 m..... 23.0 m.

3. Sandstone of light-grey colour,medium-grained polymictic,slightly calcareous ..... 6.5 m.

4. Interstratification of argillites of dark-grey colour with seams of the latter being black and coaly and of aleurolites being grey-green with vegetative detritus. In the middle part of the stratum there is a seam of calcareous samdstone being 3.5 m. in the thickness ...20.0 m.

5. Sandstone of light-grey colour,medium-grained polymictic massive-bedded,loose,slightly calcareous..... 2I.0 m.

6. Interstratification of beds of argillites being grey,dark-grey, aleurolites and less of sandstones,analogical to the described above. Among argillites and aleurolites concretions and concretional interbeds of siderite with the thickness being up to 0.I5 m. are often met;also imprints of equiseptums,small vegetative detritus. The described rocks with an aneven boundary being with erosional pockets and slightly cutting the lower beds occur on the rocks of the bed "5"..... 28.2 m.

7. Sandstone of light-grey colour,medium-grained,polymictic,slightly calcareous..... 5.5 m.

8. Thin interstratification of argillites being grey and aleurolites of grey-brown colour;there are often met concretional interbeds of siderite with the thickness of the latter being up to 0.I5 m.... 5.0 m.

9. Sandstone analogical to the bed "7"..... 5.7 m.

I0. Thin interstratification of argillites being dark-grey and of aleurolites being of dirty-grey-green colour,the thickness of the beds is 0.I-0.5 m.;interbeds of siderite with the thickness 0.I-0.I5 m. are often met. There are also imprints of equiseptums and vegetative detritus..... I6.8 m.

II. Sandstone analogical to the bed "7"..... 4.8 m.

I2. Thin interstratification analogical to the bed"I0"..6.9 m.

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I3. Sandstone analogical to the bed"7"..... 3.3 m.

I4. Interstratification of argillites being grey,dark-grey in colour and of aleurolites being grey-green in colour. At the upper part of the stratum there is a bed of hard coal being of simple structure with thin lenses of argillite the thickness of which being 0.60 m. Along the strike it is pinching out ..... 29.0 m.

I5. Sandstone analogical to the bed "7" ..... 5.2 m.

I6. Thin interstratification of argillites and of aleurolites. At the lower part of the stratum thre are interbeds of hard coal with the thickness 0.05-0.I m.,imprints of equiseptums,vegetative detritus.. 9.0 m.

I7. Interstratification of sandstones,analogical to the bed "7",of aleurolites and grey argillites,there are concretional interbeds of siderite rarely met,imprints of equiseptums. At the upper part of the section sandstones are the predominant ..... 27.7 m.

I8. Frequent interstratification of argillites being grey and dark-grey often coaly with lenses of hard coal and of dirty-grey-green aleurolites being 0.03-0.05 m. in the thickness;concretional interbeds of siderite with the thickness up to 0.I5 m.are oftem met,there are also numerous imprints of equiseptums. In one of the interbeds of aleurolites there is a fragment of a wooden column the diameter of which being near to 0.4 m.; the fragment is lying horisontally..... 48.6 m.

I9. Sandstones light-grey medium-grained polymictic,slightly calcareous.At the middle part of the section they contain interbeds of argillite with the thickness of the latter being 0.I0-0.20 m. .....I2.0 m.

20. Argillites of grey,dark-grey colour,often coaly,aleuritic with interbeds of aleurolite being up to 0.I5 m. in the thickness;at thelbwer and at the middle parts of the section there are interbeds of calcareous fine-grained sandstone with the thickness of the latter being 0.I-0,3 m; among argillites there are concretional interbeds of siderite with the thickness up to 0.I m. Three seams of hard coal bein of bedded structure with thin small lenses of argillite with the thickness(from the bottom) being respectively 0.70;0,30 and 0.25 m..... 28.6 m.

2I. Sandstone light-grey,reddish medium-grained polymictic massively - bedded slightly calcareous..... 30.0 m.

22. Argillites of grey,dark-grey colour at some places they are aleuritic and contain interbeds of aleurolites and sandstones with the thickness of the latter being 0.I0-0.30 m. Numerous concretional interbeds of siderite;at some places -lenses of hard coal with the thickness up to 0.08m. numerous imprints of equiseptums are marked here ..... 20.6 m.

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23. Sandstones analogical to the bed"2I" ..... 6.70 m.

24. Argillites of dark-grey colour,at the middle part there is a bed of aleurolite with the thickness being 0.60 m. and four beds of coal, being bedded and glittering with the thickness (from the bottom) respectively 0.I5;0.I5;0.I5;0.20,the space between the beds being from o.30 up to 0.50 m. ..... I9.I0 m.

25. Sandstone fine-and medium-grained of greenish-grey colour,slightly calcareous with calcitizated shells of pelecipodae of poor preservation ..... I.00 m.

26. Grey medium-grained sandstones,at the upper and at the lower parts - dark-grey argillites with interbeds of sooty coal with the thickness being 0.04-0.05 m.,at the basement there is a bed of sooty crumpled coal with the thickness 0.20 m. ..... 7.80 m.

27. Sandstones of grey colour,medium-grained and polymictic,at some places cross-bedded;at the middle part there is an interbeds of argillite with the thickness 0.I0 m. with numerous vegetative detritus... 8.60 m.

28. Interstratification of sandstones of grey and dark-grey colour, being medium-up to fine-grained,slightly calvareous and of aleurolites, dark-grey argillites. Aleurolites and argillites contain vegetative detritus,imprints of equiseptums. Sandstones contain imprints and cores of pelecipodae which could not be determined. At the basement there are three seams of sooty coal with the thickness 0.30 m. each,being clayey;along the strike there are plates of pinching out ..... I8.0 m.

Total thickness of "the upper part" of the Cheldukhtaran series is ..... 465.00 meters.

Above with conformity occur sandstones,aleurolites and argillites (lithologically alike the described ones) which are conditionally related already to the Rekbulan series of the Lower Jurassic age.

In the composition of "the upper part" of the Cheldukhtaran series the ratio of the rocks is as follows: sandstones -45%,aleurolites-24%, argillites-30%,hard coal-I%,that is in comparison with"the middle part" the decreasing of the role of sandstones and encreasing of the role of argillites is marked;the role of aleurolites remains on the same level; seams of hard coal appear there. By the ratio of the rocks"the upper part" of the Cheldukhtaran series differs from the Regbulan one by more encreased clay-bearing(approximately two times as much),but by decreased coal-bearing (also approximately two times as less).

The character of sediments indicates to the sedimentation in more and

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more regressing and apparently becoming shallow submarine delta, being formed at the marginal part of the fresh marine basin. The absence of a soil seam and root systems of plants, as well as absence of delicate vegetative remains, the presence of large wooden fragments, occurring at the plane of the beds, the lens-like character of the coaly seams and their contamination by a rock material all this apparently speaks in favour of allochthoneous origin of the vegetative coal-forming mass.

The R e t stage (undissected)

The deposits, related to the Ret stage, developed to the East from the Darra-i-Karaz river (to the East from the meridian of 69°00'). They are exposed at three areas with the total area of nearly I25 sq.km. A considerable by an area outcrop of these deposits is known to the South and to the West from the village of Nakhrin (65 sq.km.); small outcrops are observed to the South from the pass of Chal (5 sq.km.); at last a considerable area is composed by them at the far East of the investigated territory at the interfluve of the Zamburak, Namakab and Farkhar rivers (55km^2).

The describing deposits are represented mainly by effusive-pyroclastic rocks of medium and acid composition and by sharply subordinated to them sedimentary rocks with the total thickness being from 400 up to 800 m. Everywhere they occur with sharp angular and azimuthal unconformity (within the limits of 40-90°) on different rocks of the Paleozoic age; in the region of the Nakhrin village - on the Sillurian-Devonian deposits (the Durumbak series), in the region of the Chal pass - on the Lower Permian ones, at the interfluve area of the Zamburak-Farkhar rivers - on the Upper Carboniferous-Lower Permian and on the Carboniferous deposits.

In the describing deposits there had not been found any organic remains. Their Ret age is ascertained on the grounds of their situation in the section between the Karnii-Norii deposits and the Lower Jurassic ones. Besides it by the lithological features they are alike to the deposits of the Ret stage, described in the Southern-Central region of the investigated territory (the Ishpushtin and the Turmush series).

At the distance of I0 km. to the South-West from the village of Nakhrin one can observe how concordantly dipping in the eastern bearings as moving to the West in the following one after another outcrops the describing effusives of the Ret stage are replaced by brown-green fragmental argillites with thin interbeds of green-grey aleurolite and with seams of sandstone, often tuffogeneous and of tuff. In argillites the remains of Halobia sp. shells had been selected, which in the regions, situated to the East are characteristic for the Karnii-Norii deposits.

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Direct contact between the effusive-pyroclastic rocks of the Ret stage and the sandy-argillite rocks of the Karnii-Norii stages has not been established for poor exposureness of the rocks. However, even without this the more high stratigraphic situation of the effusives relatively to the sandy-argillite rocks with the Halobia fauna is quite evident.

At the distance of 20-25 km. to the East from the Nakrin village and further to the East by the Farkhar river the effusive-pyroclastic rocks of the Ret stage occur directly on the Paleozoic ones with a falling out from the section of the Karnii-Norii deposits. The mentioned fact apparently speaks to the favour of a stratigraphical unconformity between these strata, at least in the eastern part of the investigated territory,

The effusive-pyroclastic rocks of the undissected Ret stage in the region of the Nakrin village and at the pass of Uhal carry a thin party-coloured residual crust of weathering and transgressively overlapped by the Lower-Middle Jurassic coal-bearing deposits; in the region of the interfluve area of the Namakab-Farkhar rivers they are overlapped without noticeble crust of weathering directly by the deposits of the Callovian stage of the Upper Jurassic age.

The effusive-pyroclastic rocks of the undissected Ret stage on the whole area of their distribution are intensively folded, the folds being with different strike of their axes, the dip at the wings of the folds being from I0-I5 up to 75° (more often - 20 - 30°) what practically makes it impossible to work out a continuously section and to determine their true thickness.

Below the description of the rocks and their approximate distribution and sequence in the sections as well as approximate total thickness are given.

The deposits of the undissected Ret stage are represented by lavae, agglomeration lavae, lavabrecciae, welded tuffs and t uffs of augite porphyrite(andesite), quartzy porphyrite(dacite); in more little amount there are quartzy porphyry and diabase porphyrite and sedimentary rocks such as sandstones, aleurolites, flinty slates and sandy limestones. The sedimentary rocks are locally distributed being in sharply subordinated quantity.

Lava of augite porphyrite(andesite) has dark green-grey up to black-green colour, massive structure and porphyry texture, sometimes transitioning into porphyroid one due to a considerable crystallization of the ground mass of the rock.

The rock is composed by impregnations(30-40%) and by the ground mass. The impregnations have the size from 0.6 up to 4 mm. and being represented by augite, often in this or that degree replaced by products of alteration and by plagioclase(andesine up to labradorite). Augite is replaced by serpentine, chlorite, calcite. By plagioclase sericite, rarely

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chlorite and epidote are developed. Among impregnations quartz is rarely met.

The ground mass - is fine-up to very fine-grained, composed by laths of plagioclase, small grains of augite and of ore mineral. It has been usually intensively alterated; by the ground mass often developed chlorite, sericite, epidote and calcite.

Lava of quartzy porphyrite(dacite) - the rock of white, grey, pinkish and of greenish-pink colour, being of massive structure with porphyritic up to porphyroid texture.

The rock is composed by impregnations(20-60%) and by the ground mass. Impregnations are represented by plagioclase(andesine) and by quartz with a size from 0.5 up to 5 mm. Plagioclase is usually idiomorphic, in different degree sericitizated.

Quartz is usually melted, corroded and rarely also has idiomorphic outlines.

The ground mass generally poorly crystallysed and is composed by small grains of quartz, feldspars, fragments of glass, often with spherolitic texture. The ground mass is often chloritizated and carbonatizated.

Lava of quartzy porphyry is of pink-white, pink, grey-green colour of massive structure, sometimes with slightly pronounced fluidal bedding. Texture of the rock is porphyritic, sometimes transitioning into porphyroid one. Texture of the ground mass is microgranitic, microfelsitic.

The rock is composed by impregnations(30-40%) and by the ground mass. Impregnations are represented by (up to 80%)quartz and plagioclase. Quartz usually forms regularly outlined grains with the size up to 4 mm. Plagioclase is often zonal (from albite up to andesine), and has tabular outlines. The size of impregnations of plagioclase is different - from 0.2-0.3 up to 6-7 mm; sericitization and pelitization are observed.

The ground mass is composed by small (up to 0.04 mm.) grains of quartz(40%), common potassium feldspar(up to 40%), plagioclase, biotite, epidote, chlorite, sericite and rare impregnation of ore mineral(pyrite?) The rock is in considerable degree carbonatizated.

Agglomeration lavae, lavabrecciae and welded tuffs are representing by themselves massive rocks being from green-pink up to grey or grey-green colour. They differe from lavae in outward appearence by usual spoty colouration and well apparent to a naked eye fragmental structure. Fragments being in the size from several dozens of cm. up to 2-3 mm.; they usually have angular, sometimes smooth outlines. Side by side with angular fragments there are lapilli and volcanic bombs being of rounded form met here. By the composition these rock s are alike lavae. They have psephitic, psammitic and litocrystalloclastic texture. Tuffs represent by themselves a massive rock of grey, greenish-grey, white, brown-green colour often with inclusions of lapilli the size of which being up to the size of walnut and with inclusions of volcanic bombs, being of fusiform outline, rarely - of biscuit-like form. The quantity of lipilli and bombs is sharply ranging.

Tuffs are composed by sharpangular, rarely of melted fragments of quartz, plagioclase, felsite, microgranite aggregate and rarely by crystallized glass with spherolitic texture, the size of crystalls being up to 3 mm. Cement has an ash structure. Out from secondary minerals there are chlorite, calcite, hydrooxides of ferrum met. Sometimes amygdules filled by chlorite and zeolites are met.

Diabasic porphyrite represents by itself a dense rock of dark-green almost black colour, sometimes with violet tint, being of massive structure. Amygdaloidal varieties are met also.

The rock is composed by impregnations(I0-20%) and by the ground mass Impregnations are represented by plagioclase(labradorite) and augite. Plagioclase forms rare tabular crystalls with the size up to 3 mm., it is sometimes zonal. Augite is more often met, being in the form of xenomor-

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phic seggregations the size of which being up to 5 mm.,it is replaced by amphibole and chlorite. Sometimes seggregations of olivine with the size up to I.5 mm. are met.

The ground mass is fine-crystallized and is composed by small laths of basic plagioclase,grains of augite,replaced by hornblende and by chlorite. Accumulations of small grains of ore mineral are met. Texture of the rock is diabasic,rarely-poikiliphitic. Amygdules filled by chlorite,calcite or by zeolites are often met.

Diabase amygdaloidal is of grey,violet-grey,black-violet colour with different quantity of amygdules being of rounded form or of lolongated one,the size of which being from first mm. up to 2-3 cm.,filled by calcite,rarely by zeolites and more rarely -by chalcedony. Diabase is composed by fine-crystallized mass by the composition being alike to the decribed above in the diabasic porphyrites. Impregnations either not observed at all or they are singular. Structure of the rock is amygdaloidal texture is diabasic.

In the region located to the South and to the East from the Nakhrir village the effusive-sedimentary stratum of the Ret stage though not clearly is divided into three benches(from the basement):

I. Interstratification of lavae of augitic porphyrites and quartzy porphyrites(dacites) and of their pyroclastic derivates(lavabrecciae,welded tuffs,rarely agglomeration lavae and more rarely tuffs). Sometimes here quartzy porphyries and diabasic porphyrites are met.The thickness of some lava covers does not exceed I0-20 m. Pyroclastic rocks are more often met at the upper part of the bench,where they form beds,the thickness of which being from first up to 35 meters. Along the strike the thickness of some lava covers and benches of pyroclastic rocks is not regular;gradual replacements of one pyroclastic varieties by anotherare observed. General colour of the stratum is light-green. The thickness is up to 300 m.

2. Interstratification of lavae of augitic porphyrites,diabasic porphyrites and sharply subordinated to them lenses and seams of polymictic often tuffogeneous fine-and medium-grained sandstones,aleurolites and rarely of sandy limestones. Sandstones and aleurolites contain small vegetative detritus. Lavae and pyroclastic rocks are the predominant in the section;among them diabasic porphyrites are more often met than augitic porphyrites. Sedimentary rocks compose beds with the thickness not more than I5-I8 m. The general colour of the rocks is grey-green up to black-green. The thickness is nearly 300 m.

3. Interstratification of lavabresciae,welded tuffs and tuffs of medium composition. Lavae of basic and medium composition are present in the subordinate quantity;the thickness of separate beds does not exceed 7-8 m. Rare thin beds of tuffogeneous sandstones and aleurolites are met. In the composition of this bench tuffs are the predominant;they contain

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lapilli now rare,now more frequent,with the size up to the size of walnut; twisted and sometimes flattened volcanic bombs are not often met. General colour of the rocks is green-brown,at some places - brown. The apparent thickness is up to I20 m.

The total thickness of the effusive stratum of the Ret stage in the region of the Nakhrin village reaches 720 m.

At a number of places here dikes and stocks being of acid,medium and rarely of basic composition cutting the effusive series are observed. They are apparently being of funnel facies of the decribed above effusive-pyroclastic formations.

Further along to the North-East at the interfluve area of the Chal-Namakab-Farkhar rivers the dissection of the effusives is impossible. For example,at the up-streams of the Zamburak river basin an interstratification of lavabrecciae and welded tuffs af augitic and quartzy porphyrites, lavae of diabasic porphyrites often of amygdaloidal diabases and lavae of quartzy porphyrites could be observed. Due to the different colour(green-grey,grey,grey-black) the alternating beds and covers of different by composition rocks being in the thickness from 8-I0 up to 50-60 m. are well singled out. There is no any regularity in their situation in the section. Along the strike the replacement of lavae by pyroclastic formations and vice versa could be observed. Among the effusive rocks here lenses of blad flinty slate being in the thickness up to 5-8 m. are very rarely met.

The total thickness of the effusive stratum of the Ret deposits in the region of the Chal-Namakab ranges from 450 up to 600 m. and apparently at some places it reaches more great maltitude.

At some places,for example at the interfluve area of the Zamburak and Namakab rivers at the lower parts of the section dikes of medium and rarel of basic rocks finished by covers are observed. In the same region near the pass of Sagnilyashm a stock being nearly 0.5 km. in its diameter,composed by light yellow-pink quartzy porphyrites,which cuts the series of th Ret effusives was observed. In quartzy porphyries,near the contact with th enclosing rocks here the inmelted fragments of lavabrecciae of augitic porphyrites rarely of black schists were met. The latter is apparently Paleozoic and had been evacuated here from a considerable depths. The described stock of quartzy porphyries is considered by us to be as a remain of volcanic apparatus of one from numerous Late Triassic volcanes,acting in this region.

Among the described formations of the Ret stage there were not met any organic remains which could be determined. Their age is established mainly on the grounds of their situation in the section what was mentioned at the

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beginning of the section.

The described stratum of effusives was apparently accumulated in continental conditions. The presence at some places of beds of terrigeneous-sedimentary rocks and espesially of sandy limestones(in the region of Nakhrin) indicates to the possibility of existence at some areas of aquatic spaces apparently being bays of a sea or separated from it independent small basins.

The effusive formations of Ret are developed by a strip,running mainly along the marginal Ishkamysh suture,at the tectonic ruptures of which the chains of volcanogeneous apparatus apparently had been located,being of both fractured and central types,provided all the mass of various volcanic material,composing the Ret stage in the North-Eastern part of the territory interested to us.

The J u r a s s i c system

Within the limits of the territory interested to us the Jurassic deposits had been known beginning from the period of investigations,carried out by K.L.Grisbakh(I885,I886). More detailed study of them was carried out by G.G.Gaiden(I9II),who had singled out and described the so called "series of Saihan" in the Northern Afghanistan(in the region of Tala village,in the valley of the Saihan river and near the village of Darra-i-Suf) for the first time. The age of the Saihan series on the grounds of the determinations of flora carried out by A.S.Sijuord(I9I2) was considered to be Jurassic .

Later R.Furon(I923) collected from the same deposits in the region of the Ishpushta river valley the flora which was determined by T.M.Garris (I923) and which was considered to be of the Middle-Upper Jurassic age.

V.D.West(I940-I942) investigated "the series of Saihan" in the region of the Tala,Rafak,Ishpushta and Shabashek villages in connection with its coal-bearing. In the region of the coaly deposits of the Shabashek he had for the first time dissected "the series of Saihan" by its lithological and colour features into 4 benches ("a","b","c" and "d"). However the abundant collections of flora,determined by K.Jekob(I946) did not allow to him to spesify the age of these deposits more precisely than the Jurassic one.

E.D.Buro,R.Furon and L.F.Rosse(I950) from the Saihan deposits of the Ishpushta region had determined the flora of the Lower Lias.

S.A.Popol and S.V.Tromp(I952-I954) studing"the series of Saihan" in the region of coaly deposit of Ishpushta subdivided it into three parts: the Lower,the Middle and the Upper. On the grounds of the previo-

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us determinations of flora as well as general geological considerations they had related"the series of Saihan" as a main to the Middle and Upper Jurassic age.

It should be noted that as far back as from the times of Gaiden under the name of "series of Saihan" the stratum of terrigeneous deposits mainly with vegetative remains,being often coal-bearing and having a characteristic lithological composition and flyshoidal character of interstratification which provide to it the spesific always differing this stratum from another deposits appearence,was considered. The origin of these sediments was considered by the most number of geologists as to be continental. In the composition of "the Saihan" series G.G.Gaiden did not apparently include the marine deposits of the Upper Jurassic age.

Thus,"the series of Saihan" being not a stratigraphical notion only partly united the different by age continental facies of the Jurassic system.

In connection with the further elaboration of the stratigraphy of the Jurassic deposits in the northern Afghanistan more detailed stratigraphical subdivisions appeared,corresponding to the conventional international stratigraphic scale such as the divisions (lower,middle,upper) and stages(for the marine deposits: Callovian,Oxford,Kimmerij and Titonian). Among the continental deposits at the present time the series,benches and parts of divisions,being of local importance and for the time being an approximate correlation between each other only. In connection with the stated the using of "the series of Saihan" term should apparently be limited in the future by the frames of facial idea only,uniting the different by age,often being coal-bearing Jurassic continental deposits,having in the northern Afghanistan a specific lithological expression.

Thanks to the further investigation of the Jurassic continental coal-bearing deposits sections in the region of the coaly deposit of Dakhani-Tor, V .I.Bratash and others(I96I,I964) had dissected them into the lower and middle divisions. In the lower division "the Donitur coal-bearing series",in the middle - "the Donitur gravellite-sandstone","the Donitur green-coloured" and "the Donitur aleurite-sandstoneous" series had been singled out by him as well as an attempt to correlate them with the sections of the Doabi-Mekhzarin and Dudkash regions had been done. The marine deposits of the Upper Jurassic age in the region of the Karkara-Dudkush had been dissected by them into stages in accordance with the conventional international scale.

The sections of the Jurassic deposits in the regions of Dakhani-Tora,Doabi-Mekhzarin,Ishpushta,Dudkash and Chal had been studied not far

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long ago by G.N.Khatiskatsi, AK.Dertev(G.N.Khatiskatsi,A.K.Dertev and others,I963) who had dissected these deposits and singled out by the lithological phenomena a number of benches,which were with this or that degree of conditionality correlated one to another, The marine deposits of the Upper Jurassic age had been also dissected by them into stages and benches.

G.N.Khatiskatsi and A.K.Dertev preserve the denomination of "the series of Saihan" for the terrigeneous continental deposits with vegetative remains of the lower and middle divisions of the Jurassic age only and do not include the Upper Jurassic deposits into "the series of Saihan".

By the above mentioned investigators in the section of the Dakhani-Tor the lower division(295 m.) is dissected into benches I and II,the middle one (600 m.)- into benches III-IV,the upper division (nearly 424 m.) is dissected intobenches V,VI,VII. In the section of the Doabi-Mekhzarin in the lower division (642.0 m.) they single out the benches I,II,III,IV, V and VI,in the middle (346,0 m.)- the benches VII,VIII,IX and X. In the section of the Ishpushta the Lower Jurassic (250.0 m.) is divided into 6 benches I and II, the Middle Jurassic (825 m.) - into benches III,IV,V, VI,VII and VIII. In the section of the Dudkash among the Lower Jurassic deposits (750 m.) they single out the benches I,II,III,IV and V.,among the Middle Jurassic (200 m.)-the bench VI. In the section near the pass of Chal the Lower Jurassic (230 m.) is singled out under the denomination of " clayey-sandstone series",the Middle Jurassic (470 m.) is dissected into"sandy-conglomeratic" and clayey-sandstone" series.

The correlation of some benches and series of the inumerated sections is given according the lithological phenomenon,foe example the benches I and II of the Dakhani-Tor are correlated with the benches V and VI of the Doabi-Mekhzarin;the benches I-IV of the Doabi-Mekhzarin -with the benches I and II of the Ishpushta and with the benches I-IV of the Dudkush and so on. Taking into consideration the sharp facial changeability of the Jurassic continental deposits in the conditions of a considerable paleogeographical disconnection of these regions,as it will be shown below,such correlations are hardly appear to be convicting.

At the present stage of knowledge on the continental Jurassic deposits in the northern Afghanistan with a sufficient confidence apparently the only divisions could be correlated and only sometimes within the limits of one paleographical unit-parts of divisions and benches.

The further elaboration of the Jurassic continental deposits' stratigraphy,taking into consideration the importance of this question in connection with their coal-bearing must be carried out in order of finding out

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of more reliable phenomenon for the correlation of these deposits, based on the complex study of the sections with the application of paleophytological, palynological, lithological and paleogeographical methods.

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The deposits of the Jurassic system within the limits of the investigated territory are being exposed on a comparetively limited area. Their outcrops accupy an area of approximately 600 sq,km. or nearly 5% of the investigated territory.

The outcrops of the Jurassic deposits have a broken character and are mainly confined to the erosional-tectonic "windows" and to deeply cut in valleys of large rivers. Their limited distribution is conditioned by different factors: first of all - by non-general their initial accumulation, also by further superimposition of tectonic and erosional processes during the Pre Cretaceous and Early Cretaceous time, which lead to a sharp decreasing of the initial area of their development and at last- by tectonic movements of the Neogene-Quaternary time as well as by further erosion.

As a main the outcrops of the Jurassic deposits are taced in the zone the width of which being from 20 up to 50 km., running in the West part of the region in the latitudinal direction and in the eastern part-in the North-Eastern direction with the total extent being 270 km. In the East their distribution is limited by tectonic lines as well as by outcrops of the Paleozoic rocks, in the West they come out the limits of the investigated territory into the basins of the Bandi-Amir rivers. The most large outcrops of the Jurassic deposits which coincide with the described below coal-bearing regions, traced from the West to the East are the following:

The Darra-i-Suf - (with the deposits of hard coal the Shabashek, Karamkul, Harmak, Dakhani-Tor, Lela, Sari-Assiya, Aokhorak, etc.), with the area of the Jurassic rocks' outcrops being nearly 200 sq.km.

The Saihan-Ishpushtin (with the deposit of hard coal-the Ishpushta, the area of outcrops being nearly 88 sq.km.).

The Pul-i-Khumrian - (with the Dudkash, Karkar and Nakhrin deposits of hard coal), the area of outcrops of the Jurassic deposits being nearly 52 sq.km., and the Chal-Namakabian one- (with the Chal, Darra-i-Kolon, Zamburak, Bazarak, Roshag, Namkab, etc.), the area of the Jurassic deposits outcrops being nearly 200 km^2.

The Jurassic deposits within the limits of the mentioned regions in connection with their coal-bearing were underwent the more detailed study. In connection with the lithological changeability of the sections as

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well as with the broken character of the outcrops, the stratification of the Jurassic deposits appeared to be a very difficult task, espesially for their very poor study before. In connection with this for a number of coal-bearing regions in accordance to the international stratigraphic scale the only divisions are singled out; the more detailed dissection is possible only with the singling out of series, sub-series or parts of series and divisions, which could be only conditionally correlated one with another.

The given scheme of dissection can not pretend to be the final one and is the first attempt of correlation of the Jurassic deposits on a considerable area. As a main it could be illustrated by the following table:

Stratigraphical subdivisions,	R E G I O N S			
	Darra-i-Suf	Saihan-Ishpushtin	Pul-i-Khumrian	Chal-Namakabian
Upper division	?	?	Titonian, Kimmerij stages non-dissected.	Titonian(?)-Kimmerij stages non-dissected
			Oxford stage	Oxford-Callovian stages non-dissected
	The Bashek series*	Callovian stage,	Callovian stage (the upper part is marine, the lower one is continental).	Callovian stage Bench IV. Bench II+III Bench I
Middle division. Shabashek series**	Upper part Lower Lelai part subseries.	Middle and upper parts united Lower part	Middle division.	Middle division.
Lower division.	Regbulak series***	Lower division	Lower division.	Lower division.

* Corresponds to "the Donitur aleurote-sandstoneous series" of V.I.Bratash and others, 1964.

** Partly apparently corresponds to "the Donitur gravellite-sandstoneous" and "green-colured" series of V.I.Bratash and others, 1964.

*** The Upper part of the Regbulak series corresponds to "the Donitur coal-bearing" series of V.I.Bratash and others, 1964.

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Below the sucessive description of the singled out stratigraphical subdivisions is given.

The L o w e r division.

The deposits of the Lower division of the Jurassic system are established almost by the whole area of the Jurassic deposits' outcrops. However there are not so many places where they have a complete section. Their lithological composition and thickness underwent a considerable alteration. It could be noted that in the sections located to the South the thickness is greater than in more Northern ones.

In the West in the Darra-i-Suf region, the Lower Jurassic deposits were for the first time singled out in the region of the Dakhani-Torian coaly deposit by Bratash V.I., Egupov S.V. and others (I96I, I964) under the denomination of " the Donitur coal-bearing"series. Then later in the region of the Shabashe coaly deposit by B.N.Androsov(B.N.Androsov, N.S.Kudryashov and others, I965) and also by us the complete section of these deposits under the denomination of the Regbulak series had been described. The late denomination has been adopted for the Lower Jurassic deposits of the western part of the Darra-i-Suf coaly region; the Darra-i-Suf coal-bearing series of V.I.Bratash corresponds to the Upper and possibly to the Middle part of the Regbulan series.

In the Saihan-Ishpushtin, Pul-I-Khumrin and Ghal-Namakab regions the Lower division of the Jurassic system is singled out and dissected as an independent one in some sections into a number of lithological benches, conditionally correlated one with another only.

In the Darra-i-Suf coal-bearing region the Lower Jurassic deposits are exposed in a limited number of places and have the total area of the outcrops being 38 sq.km. The most great by the area outcrop(nearly 20 sq.km) and the most complete section of them is known at the area located between the villages of Shabashek and Chikhil-Dukhtaran, where the most complete their section is exposed. Less by the area outcrops being with partly only exposed section were established in the region of the Karam-Kul village(nearly 6 sq.km.), in the region of the Dakhani-Tor(nearly 5 km^2.) and Lela (nearly 8 km^2.) villages.

The R e g b u l a n series

For the first time the Regbulan series had been established as Lower-Middle Jurassic one, when studing the coal-bearing deposit of Shabashek (B.N.Androsov, N.S.Kudryashov and others, I965). But during the further study its age had been spesifyed and its upper boundary had been lowered for approximately 83 m. as related to the boundary established before.

At the present time the age of the Regbulak series is treated as the

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Lower Jurassic.

The stratotype of the Regbulak series is located at the distance of 0.5 km. to the North-West from the coaly deposit of the Shabashek in th sai being of the same name. Here on sandstones of the Upper Triassic ag without a noticeable unconformity occurs a series of more or less regular interstratification of fine- and medium-grained sandstones, aleurolites consolidated (argillite-like) dark-grey clays, coaly clays and of rare beds of hard coal.

The beds of consolidated clays being in the thickness from parts up to 0,7, rarely up to 2-3 m. usually contain thin interbeds (from 0.05 up to 0,I0 m.) of thin-bedded, often being micaceous, often with carbonificated vegetative detritus.

The beds of aleurolites being in the thickness from parts up to I-I5 rarely up to 8 m. of grey-brown, grey, sometimes micaceous and sandy thin-bedded foliated contain interbeds of clays being in the thickness from 0.05 up to 0.5 m. and of sandstones being fine-rarely medium-grained polymictic with the thickness of the latter being from 0.05 up to 0.3 m.

Sandstones being in the thickness up to I5.0 m. are represented by mainly by polymictic light-grey slightly calcareous varieties, often with cross bedding, contaning interbeds of aleurolites and consolidated grey rocks.

The rocks by the whole section contain fragments of wood, vegetative detritus and remains of delicate parts of plants (leafs, vai), espesially often met in fine-grained varieties of rocks. In aleurolites and consolidated clays rounded concretions are often met being up to 6-7 cm. in diameter and concretional lens-like interbeds with the thickness up to I0-I2 cm. of clayey siderite.

For the characteristic of the series we adduce the part of the section in the region of the Regbulak village (fig.29-a, dr.32). Here on the deposits of the Upper Triassic age the following rocks are conformably lying:

I. Clays consolidated being of dark-grey colour with thin interbeds of fine-grained sandstone..... ..... I.30 m.

2. Coal hard bedded (dull and glitter interbeds)..... 0.08 m.

3. Clays consolidated of dark-grey colour, aleuritic ..... 3.25 m.

4. Aleurolite of grey colour with interbeds of consolidated grey clay with vegetative detritus ..... 2.50 m.

5. Coal hard bedded (glitter and dull) with thin interbeds of fusain; dull varieties are the predominant ..... 0.40 m.

6. Thin interstratification of aleurolite being of grey

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colour and of clay being consolidated of dark-grey colour;rare interbeds of fine-grained sandstone (up to 0.35 m.),below rare concretional interbeds of siderite ..... 3.I0 m.

7. Clay consolidated of grey,dark-grey colour with numerous lens-like interbeds of sooty coal with the thickness up to I.5 cm. and of coaly clay with the thickness up to 5 cm;at the basement of the section there are beds of fine-grained sandstone with the thickness 0.30 cm..I.45 m.

8. Samdstone fine-grained aleuritic of dark-grey colour,.....0.20 m.

9. Clay consolidated of dark-grey colour with numerous lens-like interbeds of sooty coal ..... 0.30 m.

I0. Coal sooty bedded (dull and glittering varieties with thin small lenses of fusain) ..... 0.08 m.

II. Clay consolidated of dark-grey colour with vegetative detritus ..... 0.I0 m.

I2. Sandstone medium-grained with interbeds of aleurilite and consolidated clay;at the basement of the section there is a concretional interbed of siderite with the thickness 0. 2 m. ..... 4.I0 m.

I3. Interstratification of grey aleurolites,sandstones fine-grained and of grey consolidated clays with imprints of equiseptums and carbonificated vegetative detritus..... 6.35 m.

I4. Sandstone medium-grained of grey colour ..... 4.35 m.

I5. Sandstone grey from very fine- to fine-grained,at the upper part of the section transitioning into aleurolite;at the middle part of the section there is a bed of coaly argillite (nearly I m.) with an interbed of sooty coal the thickness of the latter being o.I5 m. and an interbed of concretional siderite with the thickness being 0.30 m. ..... 3.75 m.

I6. C lay consolidated dark-grey with lens-like interbeds of sooty coal and fine vegetative detritus ..... 0.40 m.

I7. Sandstone fine-grained grey with numerous fine vegetative remains ..... 0.80 m.

I8. Clay consolidated of dark-grey colour with remains of equiseptums ..... 0.45 m.

I9. Aleurolite grey with rare lenses (thickness up to 3-4 cm.) of fine-grained sandstone ..... 0.95 m.

20. Sandstone medium-grained grey,cross-bedding is noticeable here;at some places there is small vedetative detritus ..... I.I0 m.

2I. Aleurolite grey thin-bedded with vegetative detritus... 0.65 m.

22. Coal hard bedded (at the expence of glittering and dull varieties),ferruginizated,at the middle part of the section there is

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an interbed of kaolinic clay(0.Im.)..... 0.60 m.

23. Clay consolidated grey ..... 0.I0 m.

24. Interstratification of grey aleurolite transitioning to fine-grained sandstone and aleuritic consolidated clay(at the upper parts of the section aleurolites and sandstones are the predominant);at the lower part - there is a bed of medium-grained sandstone with the thickness of 3.5 m.;in some interbeds a cross-bedding and vegetative detritus could be seen ..... I3.25 m.

25. Coal hard semi-dull with thin lenses of glittering one ..... 0.30 m.

26. Thin interstratification of aleurolite,clayey aleurolite,fine-grained sandstone and rarely of grey consolidated clay, sometimes being coaly. The interbeds have the thickness of 0.05-0.30 m. Rare concretions of siderite,imprints of equiseptums are marked here ..... 6.30 m.

27. Coal hard in a bed of complicated structure. The coal forms small plates with the thickness being from 3 up to 9 cm. The interbeds dividing these plates are composed by consolidated clay and being in the thickness from 3 up to II cm. ..... 0.50 m.

28. Clay consolidated grey with numerous vegetative remains ..... 0.40 m.

29. Interstratification of grey aleurolite and of grey consolidated clay;concretional interbeds of siderite,being in the thickness up to 0.I0 m. are marked ..... 2.30 m.

The total thickness of the adduced part of the section amounts 59.4 meters.

The addused part of the section is related to the interval between the beds No.No. 57 and 26,that is approximately to the middle part of the series (fig.29-a) and quite well characterizing both the lower and the upper parts of it.

The appearence of more frequent concretions and concretional interbeds of siderite at the lower part of the section and their gradula decreasing (up to rare) at the upper part of the section should be marked.

The ratio of the rocks,composing the Regbulak series,calculated for the whole section is expressed by the following figures: sandstones amount 64%,aleurolites -20%,consolidated clays - I4%,hard coal -nearly 2%.

Coaly beds in the most number of cases have a lens-like character and are met by the whole stratum of the Regbulak series. Their thickness ranges from thin centimetre interbeds up to I.0 m,interbeds being in the thickness from 0.I0 up to 0.30 m. are the predominant;they usually

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gravitating to the beds of consolidated clays and aleurolites;with the same rocks the concretions and concretional interbeds of siderite are spatially connected. Cross bedding in sandstones and aleurolites is rare and has the angles of inclination up to 40°.

The total thickness of the Regbulak series in the stratotypical section amounts 430.0 meters.

The upper boundary of the series is somewhat relative and is drawn by the basement of sandstones' bed the thickness of which being from I5 up to 35 m.,occurring on the underlying rocks of the Regbulak series apparently with non-considerable washout (pockets,cutting out of thin beds of the below-lying part of the section) and related by us to the Middle Jurassic age. The floristic substantiation of the Lower Jurassic age of the Regbulak series could not be considered as to be sufficient. Its lowa parts occurring concordantly on the Triassic deposits are apparently Lower Jurassic ones what is also confirmed by the presence of the typical for the Lower Jurassic " aggerelic complex" of anther dust and spores. As for the upper boundary it is conditional based on the grounds of the above marked washout only,observed between the Lower and Middle divisions of the Jurassic age also at another regions of northern Afghanistam (Dudkash,Ishpushts and others).

The Regbulak series is exposed also in the South-West in the regions of coaly deposits of Dakhani-Tor and Lela.

In the region of Dakhani-Tor it has incomplete thickness and it was singled out by V.I.Bratash(V.I.Bratash,V.V.Pechnikov and others,I96I) under the name of "Donitur coal-bearing" with the apparent thickness being nearly 650 m.

The detailed study of the region of the deposit which has a very complicated geological structure had allowed to us to specify the mode of occurrence of the series as a result of which its apparent thickness was decreased up to 288 m.(from the basement of a slope in which a main adit had been driven and above it). The lithological characteristic of "the Donitur coal-bearing" series is alike the Regbulak one. The presence at the middle part of the series of two beds of hard coal being of workable thickness,one of which (with the thickness up to 4,5 m.) is the unit of exploitation at the deposit of Dakhani-Tor,appear to be sufficient.

From the rocks,underlying the industrial seam of coal(upper parts of the bench No.I) V.I.Bratash (I964) collected abundant remains of flora, out of which T.A.Sikstel and L.M.Loseva had determined the following species: Neocalamites fanensis Sixt.,Goniopteris hymenophylloides(Brongn.), Goniopteris latifolia Brick.,Cladophlebis denticulata Brongn.,cl.sp., Kugartenia sp.,Nilssonia mediana(Leck),Phoenicopsis sp.,Podozanites

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lanceolatus L.ct H.,Elatides sp.,Brachyphyllum ef.mammilare Brongn. From the same beds G.N.Khatiskatsi (I963) adduces Goniopteris latifolia Brick.,Ptilophyllum sp.,Tyrmia sp.,Podozamites sp.,Taxocladus sp.(determinations carried out by T.A.Sikstel)/

According to the conclusion of T.A.Sikstel the complex of the mentioned above flora has a mixed character and is met in Tadjikistan both in the Upper Lias as well as in the Lower parts of Dogger,in conscequence of what it can not exactly date the age of enclosing rocks and what is more-it cant determine stratigraphycal boundary between the Lower and Middle divisions of the Jurassic deposits. However this boundary is drawn by us as well as by the previous investigators (V.I.Bratash,S.V.Egupov and others,I964;G.N.Khatiskatsi and others,I963) conditionally above the exploitating bed of hard coal what is not contradicting to the conclusion of T.A.Sikstel conserning the determined by her remains of flora.

Thus,as a criteria for the drawn of the boundary between the Lower and Middle divisions of the Jurassic deposits in the region of the Dakhani *Torian coaly deposit serve two factors: the first- a noticeable lithological difference between the deposits,related to the Lower and Middle Jurassic,and the second-the presence of a washout though slightly pronounced with which the deposits of the Middle Jurassic (the Shabashek series) are superimposed on the Lower Jurassic ones.

The lithological difference had been marked also before (V.I.Bratash S.V.Egupov and others,I964). It is expressed by almost complete disappearence of coal-bearing and by the appearence of more coarse material in the above-lying deposits of the lower part of the Shabashek series(here singled out by V.I.Bratash under the name of "the Donitur gravellite-sandstoneous" series).

The washout at the boundary of the Middle and the Lower Jurassic deposits for the region of the Dakhani-Tor is marked for the first time; it is apparently slightly pronounced and not everywhere,at a number of places it has a latent character. In the valley of the Sary-Tor river, near the pass into the valley of the Shabashek river a gentle cutting by the Middle Jurassic deposits (the lower parts of the Shabashek series) of the underlying beds and small pockets in the latter,filled by rounded fragments from the underlying rocks was marked.

Further along to the South-West the deposits of the Regbulak series had been marked in the region of the Lela and Roshagi-Bolo villages(I2 km to the South-West from the Dakhani-Tor) (fig.8. dr.34). Here at the left slope of the valley in the core of an anticline fold at the extent of nearly 8 km. the stratum of the Regbulak series with the thickness nearly 284 m. is exposed. It is composed by interstratificating benches of

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brownish-green polymictic sandstones,aleurolites,consolidated clays and rarely of colay clays.

Approximately at the distance of II2 m. below ,among the grey coaly clays occurs the bed of hard coal with the thickness being 2.25 m. The general colour of the deposits is brownish-green-grey sharply distinctive from the abovelying dark-grey,almost black rocks of the Lela series of the Middle Jurassic age. Lithologically the deposits of the Regbulak series in the region of the Lela village are alike the described in the region of the Dakhani-Tor and Regbulak,but differ apparently by their coal-bearing. They contain in a non-considerable quantity concretions and concretional interbeds of siderite and very often vegetative remains including delicate parts of plants.

The sedimentation of the deposits of the Regbulak series took place apparently in the conditions of intermontane depression and has an alluvial-lake and alluvial-swampy origin,what is confirmed by quick facial changeability of the deposits,also by often pinching out of beds and even benches of the rocks,by sharp lens-like character of coaly beds and their often splinting as well as by replacement of them by coalless rocks.

In the Saihan-Ishpushtin coal-bearing region at the area of the coaly deposit of the Ishpushta the section of the lower part of the Jurassic deposits could be traced by the left slope of the valley being of the same name where on the Upper Triassic (Karnian-Norian) argillites, aleurolites and sandstones being weathered ferruginized and pearced by the passes of digging organisms with an angular unconformity (up to 35°) the following rocks are lying: a stratum of interstratificating sandstones,aleurolites and consolidated clays(fig,30,dr.40). Sandstones often contain lenses of gravellites and small-pebbly conglomerates. Aleurolites and consolidated clays contain poorly preserved vegetative remains,ferriferous concretions. At the Lo wer part of the section a slight contamination by gypsum and salt is marked. At the middle and upper parts of the section clays are often coaly,being of black colour,contain thin lenses of hard coal. At the upper part of the section beds of fine-and medium-pebbly conglomerates are met.

The section of the Lower Jurassic deposits in the region of the Ishpushta has the following structure(from the basement):

I. Lenticulating beds of grey aleurolites and consolidated clays, the latter at some places being of black colour,coaly with incrustations of hard sooty coal;brown and red consolidated clays,marbled clays,rarely yellow marbles,light grey-green consolidated clays. Among the clays the contamination by gypsum,imprints of equiseptums and ferms. From these deposits Cladophlebis sp. is determined..... 6.20 m.

2. On the rocks described in the bed "I" with a washout and pockets occur conglomerates being medium-and fine-pebbly,composed by pebbles of quartz,black chalcedony,metamorphic rocks. Cement is sandy-coaly...9.00 m

3. Interstratification of consolidated clays,aleurolites being of

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of yellow-brown colour and of sandstones being rusty spotty, sometimes reddish. Vegetative remains being carbonificated are often met....
..... 22.50 m.

4. Sandstone with lenses of conglomerates, occurring on the rocks of the bed "3" with a washout (poskets, cutting). At the upper parts the conglomerates are red-brown fine-and medium-pebbly with sand-gravelly clayey cement; at the lower part sandstone is the predominant. Cross bedding is apparent here. There are remains of ancient columns of wood, imprints of ferms of Cladophebes sp. species met ..... I3.50 m.

5. Interstratification of consolidated clays being aleuritic and of greenish-grey colour and grey sandstones being fine-grained and rusty-yellow with rare lenses of gravellites and of medium-pebbly conglomerates, aleurolites being yellowish-brown in colour, thin-platy. Interbeds and sometimes lenses have the thickness from 0.2 up to I.8 m. Sandstones and aleurolites contain ferriferous concretions. Consolidated clays are sometimes salimizated (when tased), contain imprints of plants. From theses deposits the following species have been collected: Elatides curvifolius (Dunk.) Nath., Cladophlebes argutula (Hr.) Font., Elatides sp.
..... 27.00 m.

6. Sandstone fine-grained rusty-brown, at the lower parts of the section is with the lenses of gravellite and fine-pebbly conglomerate; upwards is replaced by consolidated aleuritic clay being of greenish-grey colour with interbeds of aleurolites. At the upper part of the section there is a bed with ferruginized concretions the size of which being up to I0-I5 cm. in diameter..... I2.30 m.

The beds I-6 with the total thickness being 90.50 m. compose the lower bench (I) of the section of the lower Jurassic in the region of Ishpushta. This bench differs by rusty-brown colour and by the predominance of coarse-terrigeneous material. Above it the following rocks are concordantly occurring:

7. Interstratification of consolidated clays being brown in colour, cloddy sandy and of grey foliated aleuritic (with the thickness 0.I-0.6m) ones, and of greenish-grey aleurolites (the thickness is from 0.30 up to I.00 m.), sandstones being fine-grained of greenish-grey colour (the thickness of beds 0.30-0.50 m.). Sandstones contain lenses of gravellites and rarely of coarse gravel. In clays interbeds of black clays and vegetative detritus are marked. At the upper part of the section among black coaly clays thin lenses of glittering hard coal (with the thickness I-3cm and concretions of marcasite (up to 6 cm.) are observed here... 48.30 m.

Alternating of beds of grey-green aleurolites and of grey aleuritic

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clays with small lenses(up to I cm.) of glittering coal,less of fine-grained sandstones of rusty-brown colour with concretions of limonite (by marcasite) with the size of up to 0.I5 m. .....I9.00 m.

9. Sandstones fine-and medium-grained with lenses of gravellite and conglomerates composed by small,medium and rarely coarse pebbles of quartz (5-8%),metamorphic rocks (60%),diabases(30%) and granites(5-2%). Bedding of the rock is unclear. At the upper part of the section conglomerates are predominant. In the relief the bed provides a cliff..35.30 m.

The beds with the total thickness of I02.60 m. compose the middle (or II nd) bench of Lower Jurassic section. This bench is well noticeable on the locality due to its light greenish-grey colour. Above it the following rocks lie with conformity:

I0. Thin interstratification of sandstones being fine-grained of yellow-brown colour with lenses of gravell and of fine-pebbly conglomerate;aleurolites of the same colour or light-grey;subordinated beds of consolidated foliated grey clay sometimes being coaly,almost black with thin (up to I cm.) lenses of hard coal. The beds have thickness ffom 0.40 up to 3.00 m. Sandstones contain concretions of limonite(by marcasite) with the size up to 0,I0 m. .... 60.70 m.

II. Conglomerate medium-pebbly composed by medium-rounded pebbles of Paleozoic rocks,metamorphic schists and white quartz(up to I0%), it contains lenses and interbeds of greenish-grey sandstone (up to I m.). Cement is weak sandy-clayey ..... I8,90 m.

I2. Interstratification of sandstones being of greenish-grey colour fine-grained,loose and of aleurolites of the same colour,consolidated clays being grey,foliated with vegetative remains and interbeds of coaly clays. The beds being in the thickness from 0.80 up to 2.00 m...I4.50 m.

I3. Interstratification of consolidated grey foliated clays and of aleurolites being greenish-grey in colour (the beds with the thickness 0.5-0.8 m.). Clays are predominant .... 8.90 m.

The beds from I0 up to II th. with the total thickness being 85.0 m compose the upper (III rd.) bench of Lower Jurassic section. This bench differs for light greenish-grey with brownish tint colour.

The common stratum of the Lower Jurassic age is well marked on the locality due to its light colour,usually being yellowish-brown or greenish grey with brown tint as well as due to the bench of dark-coloured coal-bearing rocks occurring on the former with a washout and related by us to the Middle Jurassic age.

The total thickness of the Lower division of Jurassic age deposits in the region of Ishpushta amounts 294.00 meters.

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When tracing the Lower Jurassic deposits to the South-West to the region of the Doabi-Mekhzarin (nearly II km.) a gradual decreasing of the thickness could be noticed. For example,at the distance of I.5 km. to the Northwest from the village of Doabi-Mekhzarin at the left slope of the Kamard valley (fig.30.dr.39) the section of Lower Jurassic is represented by a bench the thickness of which being only 9I.00 m.,mainly composed by sandstones with interbeds of gravellite and of fine-pebbly conglomerate and at the upper part of the section -by consolidated clays with interbeds of sandstone and thin lenses of hard coal. These deposits as well as in the region of the Ishpushta occur on the partycoloured crust of weathering developed on argillites and aleurolites of the Karnian-Norian stages of Upper Triassic age with angular (up to 25°) and azimuthal (up to 20°) unconformity.

The section at the left slope of the Kamard valley near its mouth has the following structure(from the bottom):

I. Brickly-red loose sandstones and clays with bluish small spots. They fill pockets in the undrlying rocks..... 0-2.00 m.

2. Sandstones loose micaceous being of yellowish,pinkish,at certain places almost white,sometimes clayey of brown colour with interbeds of gravellite and fine-pebbly conglomerate(pebble of white quartz,black hornfel and of metamorphic rocks). From the middle and upper parts of this bench the following flora(determined by T.A.Sikstel) have been selected: Taeniopteris asiatica Brick.,Phlebopteris ex.torossa Sixt., Ph. (Laccopteria) plypodioides Brong.,Nilssonia ex gr. orientalis Heer. ..... 58.00-66.00 m.

3. Consolidated clays,grey,foliated with rare interbeds of light sandstones and aleurolites of rusty colour. At the upper part of the section there are interbeds being in the thickness 0.2-0.8 m. of coaly clays,which attach to the stratum a stripy reddish-black colour. Coaly clays at some places contain lenses of glittering hard coal with the thickness of them being from 3 up to 7 cm.,vegetative detritus,imprints of ferms' vais. In one case a lens of sooty hard coal with thin interbeds of consolidated clay with the thickness of 32 cm. have been marked ..... 25.0 m.

Further to the South the Lower Jurassic deposits are still clearly apparent at the right bank of the Kamard river,but to the South from the Saihan river are nowhere met.

In the North-eastern direction an analogical picture is observed: 4 km. off to the North-East near the villageof Rafak the deposits of Lias are absent in the section and the Middle Jurassic with unconfor-

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mity and with a crust of weathering occurs directly on the Middle Triassic effusives.

The gradual omission of the Lower parts of the Jurassic section when going from the Ishpushta to the North-East in the direction of the Barfak-i-Tala village had been marked before by V.D.West (I940-I942).

Lias age of the described deposits is confirmed accordingly to the conclusion of T.A.Sikstel and N.M.Loseva by finds of such fossils as: Phlebopteris (Laccopteris) Polipodoides Brongn.,Bh.ex gr. torosa Sixt., Taeniopteris asiatica Brick,met among the deposits of Middle and Upper Lias of Tajikistan. Since the flora had been collected at the basement and at the middle part of the very thin section,the absence here of the deposits of Lower sub-division of Lias could be supposed. Analogical idea was expressed before by G.N.Khatiskatsi and A.K.Dertev (I963).

The coal-bearing of Lower Jurassic deposits of the Ishpushtin region is extreamly low. Thin,limited in the extent lenses of clayey hard coal are marked at the basement of the section. Their thickness does not exceed 0.32 m.

Small lenses with the thickness up to 0.07 m. have been marked at the upper part of the section too. The clays enclosing hard coal as well as aleurolites side by side with small vegetative detritus contain delicate parts of plants too. This fact can testify to an autochthonous character of vegetative material accumulation.

The accumulation of Lower Jurassic deposits in the region of Ishpushta took apparently place in a separated intermontane depression,in consecquence of what this section has local specific features,expressed by the following:

I. Sharp discordant occurrence of the Lower Jurassic on different strata of Middle and Upper Triassic,which usually carry a residual crust of weathering;

2. Omission of Lower division of Lias in the section;

3. Light,rusty-yellow,rusty-grey colour of the rocks and the presence of redcolours at the lower basal part of the section;

4. Primary coarse-terrigeneous composition of the section(sandstones,gravellites,conglomerates) and,in general,sharp subordinate importance of aleurolites,clays and espesially of coaly clays;

5. Slight manifestation of coal accumulation,being of episodical character and localized on very small areas.

The inumerated as well as a number of others before mentioned features testify to the proluvial-alluvial and less - to alluvial-swampy origin of the Lower Jurassic sediments of the Ishpushtin region.

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In the Pul-i-Khumrin coal-bearing region the outcrops of the Lower Jurassic deposits are known at two areas: in the region of coaly deposits of Karkar and Dudkash and in the region of the Nakhrin village.

In the region of the Karkar and Dudkash deposits(I0 km. North-East from the town of Pul-i-Khumri) the Lower Jurassic deposits is exposed on an area being nearly 8 sq.km.,elongated by a strip of meridional direction between the valleys of Dudkash and Elevatornaya.*) On an area between the valleys of Dudkash and Sanhai a superimposition of the Lower Jurassic deposits on the Pul-I-Khumrin series of the Upper Triassic age with a washout,but not everywhere clearly pronounced is observed.

On separate areas(the valleys of Sanhach,Elevatornaya) a slight angular unconformity(up to I5°) is marked. The deposits of the Pul-i-Khumrin series here do not carry any traces of crust of weathering,but at the same time the basal beds of Jurassic age often contain in different degree rounded fragments of volcanogeneous rocks,peculiar to the Pul-i-Khumrin series.

The Lower Jurassic deposits of the Pul-i-Khumrin region (fig.8,dr. 42) are representing by themselves a quite monotonous being of flyshoid character interstratification of sandstones arkose or polymictic ones with an admixture of gravelly and fine-pebbly material,aleurolites being platy and foliated,often micaceous and of consolidated clays. Sandstones have unclearly pronounced cross bedding being of irregular thickness and are predominant commonly in the section. Aleurolites usually contain vegetative detritus. Consolidated clays are often coaly dark,almost black contain thin lenses of hard coal,which are especially frequent at the upper part of the section.

At the down-stream of the Sanhach river at the right slope of the valley the following section of the Lower Jurassic(the Lower bench) can be observed:

I. Sandstones fine-grained,of grey-brown colour massive or slightly bedded with lenses of geavellite. They contain admixture of tuffogeneous material. Cement is dense siliceous-clayey..... 23.60 m.

2. Interstratification (thickness of seams 0.4-I.2 m.,rarely up to 3.0 m.) of consolidated aleuritic clays being of grey colour and of sandstones polymictic fine-grained of brown colour. 0.6 m. from the basement of the section there is an interbed with the thickness I.8 m. of green-brown tuffogeneous sandstones of massive structure.. .25.00 m.

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*) A nameless valley falling into the valley of Surkhab from the right opposite the Pul-i-Khumrin elevator.

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3. Consolidated clays of grey colour slightly aleuritic, slightly micaceous fragmental ..... I0.90 m.

4. Interstratification of sandstones being arkose fine-grained of pinlish-grey and brownish-grey colour, aleurolites thinplaty and consolidated clays of dark-grey colour. Interbeds of sandstone have the thickness from 0.2 up to 3.0 m., interbeds of aleurolites and consolidated clays - from 0.2 up to 4.5 m. Aleurolites and consolidated clays are the predominant..... 54.60 m.

5. Consolidated clays, at some places aleuritic and micaceous with thin (thickness from 0.0I up to 0.20 m.) interbeds of aleurolite of greenish-grey colour ..... 20.00 m.

6. Sandstone quartzy-feldspatic fine-grained of pinkish-grey, brownish-grey colour, dense ..... . 4.00 m.

7. Interstratification of consolidated clay of light-brown, brown-grey colour and of aleurolite being platy, foliated of the same colour (thickness of beds 0.2-I.2 m.). Clays and aleurolites contain carbonificated vegetative detritus, imprints of ferms ..... 3I.00 m.

8. Interstratification of sandstone being light-grey arkose fine-grained and of dark-grey consolidated clay (the thickness of beds being 0.8-I.0 m.)..... 4.80 m.

Total thickness of the bench is ..... I74.00 m.

In this part of the section the ratio of the rocks is the following: sandstones - 3I%, aleurolites - 26%, consolidated clays - 43 %.

Above the alike interstratification being analogical in general to the described just before of sandstones (sometimes with gravellites and conglomerates) aleurolites and consolidated clays.

For the characteristic we adduce one more fragment of the upper part of the Lower Jurassic section. At the interstream area of the Sanhach and Dudkash rivers, 400 m. from the basement of the Lower Jurassic the following rocks occur (from the bottom):

I. Conglomerate of brownish colour fine-pebbly, gravellitic with lenses of sandstone. Pebbles of quartz, quartzite and chalcedony are well rounded ..... 2.2o m.

2. Sandstone grey fine-grained quartzy-feldspatic with calcareous-ferriferous cement, cross-bedded..... 23.50 m.

3. Sandstone grey fine-grained quartzy with ferriferous concretions ..... II.80 m.

4. Clay consolidated, grey fragmental with carbonificated vegetative remains and numerous brown ferriferous concretions..... 6.00 m.

5. Sandstone pinkish fine-grained, quartzy calcareous and calcareous-

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ferriferous,cross-bedded.....I.00-3.00 m.

6. Interstratification (thickness of beds I.0-I,5 m.) of aleurolites being pinkish fine-grained calcareous and of consolidated clays of grey colour contaning carbonificated vegetative remains .....I0.0-I6.0 m

7. Sandstone pinkish fine-grained,quartzy-calcareous at some places calcareous-ferriferous.. ..... I0.5-I3.5 m

8. Clay consolidated grey with small remains of equiseptums and with carbonificated vegetative detritus,with interbeds being in the thickness up to 0.6 m. of coaly clay and of sandstones(0.8-2.0 m.),also of pinkish quartzy with brown tints ferriferous concretions..... 2I.00 m.

9. Sandstone pink fine-grained quartzy-feldspatic calcareous-ferriferous with fragments of tuff ....., 4.20 m.

I0.Clay consolidated bluish with interbeds of coal and aleurite,being of grey colour with concretions of siderite ..... 9.5-II.0 m.

II. Sandstone pink fine-grained calcareous polymictic with fragments of tuff ..... 0.8 - I.0 m.

I2. Clay consolidated analogical in the bed No.I0..... 4.0 m.

I3. Interstratification of sandstones being quartzy-feldspatic and of aleurolits calcareous ..... 3.5 m.

I4. Clay consolidated grey and dark-grey coaly with rounded boulders (in diameter being up to 0.3-0.4 m.) representing by itself in the most number of cases volcanic bombs,composed by lithoclastic and ashy tuffs.. ..... I0.0 m.

I5. Aleurolite pink quartz-feldspatic ..... 2.5 m.

I6. Clay consolidated grey coaly,analogical to that of bed No.I4, contains vegetative remains. From this bench the following fossils have been collected:Sphanobaieria sp.,Phoenicopsis sp. .....34.0 m.

I7. Sandstone pink fine-grained polymictic calcareous with pebbles composed by grey clay,with vegetative detritus..... 6.0-7.5 m.

The total thickness of the described section amounts I70-I74.7 m.

In the adduced section the ratio of the rocks is the following: conglomerates -I%,sandstones-39,5%,aleurolites - 7%,consolidated clays - 52%,hard coal - 0.5%.

The upper parts of Lias differ for somewhat heightened coal-bearin, For the characteristic the following section can be adduced,constucted for the valley of Dudkash (from the bottom):

I. Irregular interstratification of consolidated clays,sometimes being coaly (thickness of beds 0.20-2.00 m.) with rare lenses of sooty coal the thickness of the latter being 0.50 - 0.25 m. and of grey micaceous clody aleurolites with the thickness from 0.I0-up to 0.50 m. Rare

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interbeds of yellow-grey fine-grained micaceous sandstone with the thickness up to I.40 m. are observed..... 9.00 m.

2. Interstratification of sandstones being grey,brownish,fine-grained micaceous with ferriferous concretions (thickness of beds is 0.20-2.60 m) of aleurolites being greyish-green micaceous and of rare beds of consolidated clay being grey aleuritic(thickness of beds 0.20-0.65 m.)..... ..... 7.00 m.

3. Interstratification of sanstones of yellow-brown colour fine-grained,of aleurolites grey micaceous and consolidated clays of grey colour sometimes with vegetative detritus. The interbeds have the thickness from 0.20 up to I.50 m. Lenses of hard sooty coal (3 lenses) have the thickness from 0.I0 up to 0.45 m..... II.20 m.

4. Sandstone grey,yellowish-grey fine-grained quartzy with calcareous-clayey cement and small pebbles of quartz,chalcedony,limestone,etc.. ..... I0.00 m.

5. Aleurolite grey clayey with thin (thickness from 0.2 up to 0.50m) interbeds of fine-grained sandstone ..... I8.00 m.

6. Sandstone yellowish-grey fine-grained quartzy,at some places ferruginized,unclearly bedded with clayey-carbonaceous cement;at the basement of the section a small washout is noticeable..... 26.00 m.

7. Clay consolidated brownish aleuritic at some places sandy,thin-bedded,at some places coaly with small vegetative detritus and thin (up to 2 cm.) lenses of sooty coal ..... II.4 m.

8. Sandstone yellowish-brown fine-grained dense with ferriferous rusty spots ..... I2.0 m.

9. Clay consolidated of grey colour lumpy with rare interbeds of fine-grained sandstone the thickness of which being up to 0.20 m. At some places the clay is contaning vegetative detritus .....4.20 m.

I0. Sandstone yellowish-brown quartzy fine-grained calcareous.... ..... 3.00 m.

II. Clay consolidated analogical to that of the Bed "9" ... 3.70 m.

I2. Sandstone yellowish-brownish fine-grained dense with clayey -carbonaceous cement .... 2.80 m.

I3. Clay consolidated,analogical to the bed "9". At the middle part two closed beds of hard coal with the thickness of 0.80-0.85 m. divided by interbed of coaly clay being in the thickness 0.40 m. are observed ..... 5.60 m.

I4. Sandstone analogical to that in the bed No."I2". At the upper part in it there is a bed of grey consolidated clay with the thickness 0.50 m. and with amall lenses the thickness of which being up to Icm. of sooty coal..... ..... 4.50 m.

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I5. Consolidated clay dark-grey with interbeds of aleurolite and coaly clay with three lenses of hard coal,the thickness of which being from 0.05 up to 0.69 m. From clays and aleurolites collected remains of plants from which T.A.Sikstel and N.M.Loseva have determined the following species: Phkebopteris polipodiodies Brong.,Neocalamites ex gr.rugosus Szc.,Neocalamites sp.,Podozamites ex gr. lanceolatus L.et H.,Podozamites sp.,Sphenobaiera sp. ..... I5.60 m.

I6. Sandstone brownish-grey fine-grained up to medium-grained with numerous ferriferous spots. Cross bedding is clearly pronounced with an angle of up to 25°,flattening towards the lower parts of the section (of bottom current type)..... I6.80 m.

I7. Aleurolites grey thinbedded foliated alternating with consolidated clays of grey colour. At the upper parts the consolidated clays are predominant,rare interbeds of sandstones the thickness of which being up to 0.I0 m.,being consolidated almost black coaly clays with the thickness up to I cm.;root systems and separate poorly preserved wooden columns, standing in vertical position with the diameter up to I0 cm. are marked. All the rocks are micaceous.At the middle part of the section up to II interbeds of sooty hard coal with the thickness being from 0.05 up to 0.50 m.,accompanying by thin interbeds of strongly ferruginized clay are marked .... 24.20 m.

The total thickness of the described part of the section is I85.00 m

In the described part of the section the ratio of the rocks is approaching to that,which was adduced before for the middle part of Lias,but coal saturation here is rather high(nearly I%),what had been marked before also by G.N.Khatiskatsi and A.K.Dertev(I963).

Above with a noticeable washout occur sandstones of middle division of Jurassic age.

A number of beds of hard coal with the thickness being from 0.50 up to 0.90 m.,described in details in the section "Coal-bearing" (Dudkash western,Sanhach western) has been established by us here.

The total thickness of the deposits of lower division of Jurassic age in the region of the Karkara-Dudkash amounts 768.0 m. They with a noticeable washout but without apparent angular unconformity are overlapped by the deposits of middle division.

The lower Jurassic age of the described above deposits is confirmed by the determinations of spore-pollen complexes and of vegetative remains

From the basement of the section by T.A.Kuznetsova two complexes

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of sporae and pollen*) have been determined.

The first complex is represented by Aggerella aff.corolaria and Agg. sp.

This complex had been singled out by V.S.Malyavkina(I953) under the name of "aggerel complex" from the lower Jurassic deposits of the Ural-Emben region. It is characteristic according to the data of V.S.Malyavkina for the very lower horizons of the lower Jurassic deposits.

The second complex is represented by sporae and pollen. There are sporae of lycopods (Lycopodium,Selaginella) -I3%;sporae of pteridophytes: Ophioglossum sp.-II.8%;Maratioceal up to 2%; representatives of Matoniaceal family - nearly 27% and Schizaceae -more than 2%,Mausmaunia leeiana S ze. - 4.2%,Dictyphyllum -2.8%; Coniopteris sp.-3.5 %,etc. have been established. The pollen is represented by ancient caniferous of Protoconiferous furarius (Nausis.) Bolkh. type - 6.3%,also Paleoconiferous assacatus Bolkh.-I.4%,Podozamifoceae and Araucariaceae.

Rare Triassic fossils -aff. Crassulina gigantea f.typica Mal., Protopodocarpus sp. and others are present here. According to the conclusion of T.N.Kuznetsova the second complex shows a resemblence with the spora-pollen complex of the lower Lias of the Ferganian ridge,singled out by Ju.M.Kuzichkina (I962).

From the upper part of the section by T.A.Kuznetsova the spora-pollen complex of the following composition has been determined: sporae of yong ferns of the Diksoniceae family - more than I7%,representatives of the family Selaginellaceaea,Polipodiaceae (Cheiropleura congregata Bolk.,Cheiropleura Bolkh.), Cyatheaceae;sporae of the family Matoniacea -7%,sporae of Schizaea aff.pennula are often met,the pollen has more high content of ginkgoaceous and araucarians. Pollen of the family Pinaceae of yong appearence is present;considerable percent of pollen of the Cupressaceae family,pollen of ancient coniferous : Baleoconiferous assacatus Bolkh.,Protoconiferous funarius (Naum.) bolkh.,Coniferae in det are met . According to the conclusion of T.A.Kuznetsova this spora-pollen complex should be considered as a transitional one from lower Jurassic deposits to middle Jurassic ones.

Determination of vegetative remains,collected from the lower and middle parts of the section did not provide any results. Remains of flora from the upper part of the section,adduced above (when describing the section),according to the conclusion of T.A.Sikstel and N.M.Loseva contain Phlebopteris polipodioides Brongn,which is characteristic for the Lias deposits of Tajikistan.

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*) Collections of A.K.Dertev,JuM.Shakhijanov,T.A.Kuznetsova and ours.

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The upper boundary of Lias besides the adduced palynological and paleophytological data is fixed also by the presence of a non-considerable washout, with which the abovelying sandstones of the middle Jurassic age occur on the coal-bearing aleurolites and consolidated clays of the upper parts of Lias stage. This washout is fixed at the boundary of Lias and Dogger in another regions of the investigated territory also.

The lower Jurassic deposits of the Karkara-Dudkash region have been accumulated at the marginal part of a vast depression and have an alluvial-swampy origin.

The deposits of Lias being of somewhat other character have been observed at the distance of 30 km. to the East from the Karkara-Dudkash, in the region of the Nakhrin village.

In the sections of lower Jurassic of the Karkara-Dudkash the appearence of rare beds of tuffogeneous rocks of medium composition had already been marked. To the East and North-East the quantity of tuffs at the lower part of the section is sharply increased ;there also lavas of medium composition appear.

In the section near the village of Nakhrin (fig.29.dr.44) the lower Jurassic is difficult to divide from the middle Jurassic. Only supposedly to the lower Jurassic here the benches "a","b" and "c" can be related,as already in the next bench"d" the middle Jurassic flora had been collected.

This lower part of the section at the basement is composed by lavas of plagioporphyries,tuffs and tuffo-sandstones,which are above by the section replaced by alternating beds of consolidated clays,aleurolits and sandstones. The latter contain lenses of gravellites and small-pebbly conglomerates. Consolidated clays,being often coaly,contain thin small lenses of glittering hard coal. At the upper part of the section the coal-saturation is noticeably increased;the thickness of separate coaly beds reashes 0.45 m.

In the region of the Nakhrin village (fig.29,dr.44) the lower Jurassic section has the following structure (from the bottom):

I. Lava of plagioporphyry of white,grey,pink,rarely of yellowish and light greenish-grey colour. It has a massive structure. Separate interbeds are unclearly pronounced..... 75.00 m.

2. Alternating of grey tuffs being of medium composition,of lavas being of white,at the lower part - of dark-grey colour,analogical to the bed "I" and tuffo-sandstones of light and yellowish-grey colour. Interbeds of gravellites and conglomerates (pebbles of quartz,black chalcedony) are often met. The beds with the thickness being from 0.6 up to I.5m

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rarely up to 3.0 m. ..... 55.00 m.

3. Clays consolidated of dark-grey colour micaceous with interbeds of sandstones being fine-grained, greenish-grey with an admixture of tuffy material, the thickness of the beds being 0.2-0.4 m.; rare interbeds of black coaly clays ..... 20.0 m.

4. Sandstone greenish-grey polymictic fine-grained dense with an admixture of tuffy material..... 2.00 m.

5. Clays consolidated, analogical to those in the bed "3". In the sandstones there is a fine vegetative detritus .....37.00 m.

6. Sandstone analogical to that in the bed "4"..... 3.00 m.

7. Clay consolidated, analogical to that in the bed "3". Besides interbeds of sandstones there are beds with the thickness up to 0.4 m. of platy micaceous aleurolite contaning vegetative detritus and imprints of vais of ferns ..... 37.00 m.

8. Sandstone greenish-grey, dirty-green, medium-and fine-grained, dense, at the upper part is platy with lenses of gravellite and fine-pebbly conglomerate (pebble composed by white quartz and black chalcedony)..... ..... 20.00 m.

9, Interstratification of greenish-grey platy aleurolites and black coaly argillites. Aleurolites are predominant .... 4.00 m.

I0. Sandstone greenish-grey polymictic dense with interbeds of gravellite and fine-pebbly conglomerate(pebbles composed by white quarts and black chalcedony) ..... 55.90 m.

II. Thin interstratification of clays consolidated, sometimes coaly, of platy aleurolites and rarely of sandstones. Among these rocks there are three beds of hard coal with the thickness being respectively o.35, 0.35; and 0.45 m. divided by interbeds of rock being in the thickness from 0.30 up to 0.80 m. ..... I0.00 m.

The total thickness by the section is .. 3I3.00 m.

The described deposits by an irregular(washed out?) surface are superimposed on the more dark-coloured effusives of the upper Triassic age and are overlapped (possibly with a slight washout) by conglomerates and sandstones of middle Jurassic age.

In the Chal-Namakab coal-bearing region the deposits of the lower division have a wide distribution, but in conscequence of a monotony of the section and complicated tectonic conditions they are either non-divided from the middle Jurassic, or singled out very conditionally. Their common characteristic feature is still more great importance in comparison with the Pul-i-Khumrin region of volcanogeneous rocks.

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For example, in the section near the pass of Chal (fig.8,dr.45) on the effusive and pyroclastic rocks of medium composition,which are related by us to the Ret stage, are without a noticeable washout and break occurring conglomeratic lavas (fragments up to 0.50 m. in diameter), welded tuffs of quartzy porphyrites of yellow-brown colour,lava-breccia (the predominant). They compose beds with the thickness being from some up to 20-30 m.,often containing benches of thin-bedded sedimentary rocks -aleurolites being fine-grained ,often tuffogeneous,of sandstones and consolidated aleuritic brownish-grey clays,coaly black clays. The benches of sedimentary rocks have the thickness from 2-3 up to I5-20 m. Among black coaly clays thin lenses(up to 5-6 cm.)of glittering hard coal are often met.

Volcanogeneous and tuffogeneous formations,mainly occurring at the lower and middle parts of the section,amount from 90 up to 60% out from all the composing it rocks. Towards the upper part of the section the quntity of sedimentary rocks is gradually increasing. Complete dissapearence of volcanogeneous formations is considered to be in this region as a boundary between Lias and Dogger stage.

The apparent thickness of the rocks described near the pass of Chal amounts nearly 350 m. However,further along to the East under a monoclinal occurrence there can be seen several separate outcrops of analogical rocks with interbeds of tuffs and tuffogeneous sandstones, which are related by us also to lower Jurassic. Thus,the thickness of Lias deposits in the region of the pass Chal can be approximately estimated as to be within the limits of 500 m.

At the basement of the section near the pass ofChal among the consolidated clays and aleurolites the remains of flora have been collected among which T.A.Sikstel and N.M.Loseva determined the following species: Neocalamites caveveri (Zeil.) Hale.,the presence of which testifies to the lower Jurassic age of the country deposits.

The alike section is observed in the region of coaly deposit of the Darra-i-Kolon which has the following structure (from the bottom)*):

I. Sandstone grey coarse-and medium-grained,quartz-feldspatic with tuffogeneous material,with rare small pebbles of quartz....20.00 m.

2. Clay consolidated being of dark-grey colour,sometimes black with small vegetative detritus,with thin lenses of semi-dull hard coal (I-8 mm.),interbeds of sandstone,analogical to that of the bed "I" and of aleurolite being foliated of brownish-grey colour..... 22.00 m.

3. Lava-brecciae of greenish-grey colour with impregnations of quartz,being of massive structure.....I0.00 m.

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4. Sandstone grey,coarse-and medium-grained with an admixture of tuffogeneous material and interbeds at the middle part of yellow-brown aleurolites,apparently tuffogeneous with small vegetative detritus.... ..... II.00 m.

5. Aleurolites grey-brown,micaceous,now foliated,now lumpy with thin interbeds of fine-grained sandstones with small vegetative detritus... ..... I5.00 m.

6. Interstratification of grey brownish sandstones being fine-and medium-grained (the beds with the thickness from 0.2-0.3 up to 3.0 m.) with unclear cross bedding and of aleurolites being analogical to those in the bed "4"..... I2.00 m.

7. Welded tuff of green-grey colour with small impregnations of quartz..... 8.00 m.

8. Aleurolites analogical to the described in the bed"4" with rare interbeds of consolidated grey clays,sometimes being coaly and almost black with thin lenses with the thickness up to 3 cm. of semi-dull coal..... 27.00 m.

9. Sandstones grey,greenish-grey medium-grained tuffogeneous with interbeds (rare) of aleurolites..... I4.00 m.

I0. Aleurolites grey-brown thin-foliated micaceous with small vegetative carbonificated detritus.....I2.5 m.

II. Sandstone grey fine- and medium-grained with an admixture of tuffogeneous material,with lenses of gravell,with rare small pebbles of quartz and black chalcedony. Unclear cross-bedding is apparent...I8.50 m

I2. Interstratification of grey brownish foliated aleurolites and of grey lumpy consolidated clays,sometimes being coaly dark-coloured. In this bench there are two beds of hard coal of complicated structure:the lower -with the thickness of I.08 m.,and the upper -thickness is 0.96 m. The distance between the beds is nearly I0 m..... 25.00 m.

I3. Interstratification analogical to that in the bed "5"..I2.70 m.

I4. Aleurolites,analogical to those in the bed "8" with thin interbeds of fine-grained sandstones and consolidated clays ....I6.30 m.

I5. Sandstones grey,dark-grey fine-and medium-grained,sometimes coarse-grained with gravell and rare pebbles of quartz,with interbeds of foliated aleurolite with the thickness of the latter up to I.20 m. ... .I8,70 m.

I6. Interstratification of aleurolites being grey,greyish-brown,now foliated,now lumpy with small vegetative detritus and of rare beds of sandstone being fine-grained of greenish-brown colour,tuffogeneous with the thickness of beds from 0.80 up to 6.7 m. ..... 96.20 m.

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I7. Consolidated clays being grey,often coaly black with thin interbeds of aleurolites and with a great amount of vegetative detritus. At the middle part they contain up to five rapproched small beds of semi-dull,sometimes sooty hard coal with the thickness being respectively from 0.05 up to 0.20 m..... I0.30 m.

I8. Sandstones of greenish-brown colour dense tuffogeneous,transitioning into tuffs of massive structure ..... 8,80 m.

I9. Aleurolites grey-brown foliated micaceous with interbeds of dark-grey consolidated clays,the thickness being up to I.0 m....II.0 m.

20. Welded tuff of grey-greencolour with small impregnations of quartz of massive structure.....I0.00 m,

2I. Interstratification of grey,grey-brown foliated sometimes lumpy aleurolites with small vegetative detritus,with rare interbeds of grey and black sonsolidated clay the thickness of which being up to ∅. 0.60 m. and with interbeds of sandstones being fine-grained of green-grey colour with admixture of tuffogeneous material,sometimes being tuffogeneous,the thickness of these interbeds is from 5 to I0 m. ... . 33.00 m.

22. Tuffs of green colour,massive ..... 8.00 m.

The total thickness of the section is ..... 350.00 m.

The ratio of the rocks in the described section is the following: sandstones -27,5%,aleurolites-40%,consolidated clays-I8%,volcanogeneous and tuffogeneous rocks - I4%,hard coal - 0.5%.

In the section of coal-manifestation of the Darra-i-Kolon,described above a small quantity of volcanogeneous rocks attracts the attention, though the tuffogeneous material is marked by the whole section. The boundary with the middle Jurassic deposits as well as in another places of the region,is conditionally drawn by the upper bed of tuffs.

In the section of the Darra-i-Kolon aleurolites are the predominant. The character of bedding is horizontal or unclearly cross.A non-considerable presence of gravell and small pebbles in sandstones is marked Concretions of siderite are almost absent. Vegetative remains are usually of poor preservation,often in the form of detritus. Apparently all this testifies to the sedimentation in a flowing shallow basin,only periodically drained and swamped.

9-I0 km. to the East from the Darra-i-Kolon in the valley of the Zamburak river,the section of lower Jurassic again contains a great quantity of volcanic and tuffogeneous rocks (up to 80% by thickness)

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(fig.30,dr.46). The composition of volcanic rocks is the same:at the basement of the section - there are lavas of quartzy porphyries,agglomeration lavas,often welded tuffs being of brown,greenish-brown,greenish-grey tints. Above the section the volcanic rocks leave the place for the tuffogeneous ones. Benches of sedimentary rocks (sandstones,aleurolites and consolidated,often being coaly clays at the lower part of the section have the thickness expressed by the first meters,at the middle and upper ones they are predominant. Seams of hard coal with the thickness up to 0.70 m. being in quantity of 2-3 occur among effusives (for example lavabrecciae) either being divided from the latter by thin interbeds of consolidated clays and aleurolites (the thickness of which is up to 0.05 m.) or directly contacting with them. Coals carry all the features of thermal metamorphism and are usually represented by hard varieties (see description of coal-manifestation of Zamburak II).

The thickness of the deposits of the Jurassic age in the valley of Zamburak does not exceed 325 m.

Further to the East the lower Jurassic deposits are not exposed; at the upper part of the Kishakton basin a complete their omission in the section is established.

Approximately 5 km. to the South from the village of Zamburak in the region of coal-manifestation of Bazarak there are outcrops of undissected Lower-Middle Jurassic,represented by consolidated grey clays with beds of aleurolites,light arkose sandstones and lustrous hard coal with the thickness from 0.44 up to I.92 m. (fig.30,dr.47). From these beds the remains of fossil flora Coniopteris sp.,Nilssonia sp.,Equisetifes sp Neocalamites canevei (Zeil) Halle have been selected,which is according to the conclusion of T.A.Sikstel and N.M.Loseva not not older than Upper Liasic.

The apparent thickness of the Lower-Middle Jurassic deposits in the region of Bazarak does not exceed 600 m.,out of which apparently for Lias not more than 250-360 m. is left.

The lower boundary of Lias in the most number of cases is fixed well even when these deposits directly occur on the effusives of Ret stage, which have the alike lithological character. In some cases this boundary is stressed by an uneven surface of a washout as well as by filling of pockets in the effusives of Ret stage by redcoloured and brown clays, sandstones and conglomerates,partly composed by pebbles of the same Upper Triassic lavas. These rocks compose unpersistent,but very characteristic basal bench of the lower Jurassic section with the thickness not more than I-I.5 m.

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The upper boundary,as it was pointed out above,is everywhere drawn conditionally by the last upper bed of volcanic or more often of tuffogeneous rocks (tuff-tuffogeneous sandstone),what is of course,ix unreliable at all,but being for the present time the only criteria for the dividing of the upper and middle Jurassic deposits in this region. It should be noted that the stratigraphical level of this boundary here on a vast area is still remains the same,and the thickness of lower Jurassic deposits does not exceed 500 m.,decreasing at some places up to 325 m.

The lower Jurassic deposits had apparently been accumulating in the regions situated to the South of the line of Bazarak-Kishakton.

The deposits of lower Jurassic age on a very considerable area,traced from the Karkara-Dudkush in the West up to the Chal-Namakab in the East,as it could be seen from the adduced sections are characterized side by side with the accumulation of sedimentary- terrigeneous formations by the presence of volcanic rocks as well. In the West (Karkar-Dudkush) the role of volcanic formations is not great. In the East and in the North-East in separate regions such as Nakhrin,Chal,Zamburak their quantity in the section is sharply increased. The thickness of volcanic formations and the genral saturation of the section by them is not constant and ranges at a short distance. The latter is apparently connected with the fact that the centers of volcanic eruptions were not singular. They were situated along the intermontane depresssion,filled by terrigeneous alluvial-proluvial and alluvial-swampy deposits,with periodically appearing on them spots of swamps with abundant vegetation,providing the primary material for the formation of lenses of hard coal. Sedimentation, especially at the initial stages,at some places was interrupted by eruptions of lavas and outbrusts of pyroclastic material. In analogical cases of course,it was difficult to expect the formation of quitex sufficient by thickness and extent seams of hard coal. It is possible that the more favorable conditions for the coal-accumulation were the regions,remoted from the sources of removal of terrigeneous material (to the North and North-West from the investigated region),but they in consequence of the peculiarities of the recent structure are found deeply covered by more young deposits and the character of sediments in their limits is not known yet.

The L o w e r - M i d d l e d i v i s i o n s undissected

The undissected deposits of the lower-middle divisions of Jurassic system are met in the East of the investigated territory within the limits

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of the Pul-i-Khumrin and Chal-Namakab coal-bearing regions.

In the Pul-i-Khumrin coal-bearing region near the village of Nakhrin (fig.29,dr.44) in the section the deposits of Lias are singled out conditionally (benche "a","b" and "c") and of Dogger also,however,on the whole area in this region in the scale of the compiled map they could not be divided for the complicated mode of their occurrence and for the lack of reliable reference horizons. The lithologo-petrographic characteristic of the describing deposits as well as their thickness can be seen from the descriptions of the sections of the lower and middle divisions of Jurassic deposits,adduced in the corresponding sections of the chapter.

In the Chal-Namakab coal-bearing region the undissected deposits of lower-middle divisions of Jurassic system are singled out on a limited area in the region of the villages of Kalu (totthe South from the Darra-i-Kolon river) and in the basin of the Bazarak river. Their dissection here appeared to be impossible,on one hand in connection with a monotonous lithological composition and for the lack of reference horizons,and in connection with the absence of remains of flora which couH be determined on the other.

The deposits of lower-middle divisions of Jurassic system in the region of the Kalu village are repzesented by dark-grey up to black fragmental argillite-like clays with interbeds of sisliceous clays and of grey-green clays with an admixture of tuff material (thickness of beds 0.03 up to 0.30 m.) as well as by numerous rounded concretions of clayey siderite with the size up to 0.20 m. in diameter. Rare benches with the thickness up to I.0 m. of black consolidated clay. Rare beds of light qм quartz-feldspatic medium-grained,sometimes tuffogeneous sandstone with separate small pebbles and lenses of comglomerate. Thickness of sandstone beds ranges from I.5 up to 3.0 m. The total apparent thickness of lower-middle Jurassic deposits for a complicated mode of occurrence can be determined orientally within the limits of 300 - 400 m.

The rocks of the middle-lower Jurassic age in the region of the Kaly village occur on effusives of the Upper Triassic by a sharp boundary, but without any traces of weathering. of the latter.

In the basin of the Bazarak river(fig.30-a,dr.47) in the composition of lower-middle Jurassic deposits a somewhat more amount of beds of coarse-terrigeneous rocks- green and greenish-grey sandstones and small-pebbled conglomerates are marked. At the upper parts of the section benches of interstratificating aleurolites and black coaly consolidated clays with interbeds of coal,the thickness being from first cm. upto I0-I5 cm.

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The total thickness of the undissected deposits of lower-middle Jurassic deposits for the complicated tectonics can be established orientally only being within the limits of 400 m.

The fossil remains of flora, collected from different places do not provide a correct dating, but according to the conclusion of T.A.Sikstel and N.M.Loseva they do not contradict either to the Lower Jurassic or Middle Jurassic age of these deposits.

In the basin of the Bazarak river the described deposits occur with a washout on the effusives of Upper Triassic.

In the region of interfluve area of the Chal-Namakab rivers the overlapping of the lower-middle Jurassic deposits by the basal bench of the Upper Jurassic deposits(bench No.I) is marked on considerable areas, for all this at some places, for example at the right slope of the middle part of the Pitowak river valley a clear unconformity can be observed, expressed by the cutting of the deposits of lower-middle Jurassic by the bed of basal upper Jurassic sandstones under the angle of up to I0°. At another places the alike angular unconformity has not been observed by us.

The M i d d l e division.

Among Jurassic deposits of the territory interesting to us the deposits of middle division have the most wide distribution. They occupy up to 70% of the area of Jurassic deposits outcrops. With them at a number of places, for instance, in the Darra-i-Sufian coal-bearing region the practically most interesting accumulation of hard coal (Lela, Shabashek, Darra-i-Harmak) have been connected. In connection with this, this part of Jurassic section underwent a comparetively more detailed study.

The section of middle Jurassic deposits had been studied also before in a number of regions.

For example, in the Darra-i-Suf coal-bearing region by V.I.Bratash, V.V.Pechnikov, S.V.Egupov and others (I96I, I964) the Jurassic section of the coaly deposit of Dakhani-Tor had been studied. In this region on the grounds of lithological differences the middle Jurassic deposits had been dissected into three series(from the bottom): " the Donitur gravellite-sandsoneous" -490 m., "the Donitur greencoloured" - 480 m. and "the Donitur aleurite-sandstoneous" -305 m. Thus, the total thickness of middle Jurassic deposits had been determined by them in the regions of Dakhani-Tor as to be I275 m.

Later in the same region G.N.Khatiskatsi, A.K.Dertev and others (I963) to the middle Jurassic had related only the part of the section, described by V.I.Bratash and others, the thickness of which being only 8I0-820 m. For all this the lower boundary of middle Jurassic remains,

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in general at the previous level; the upper one was drawn considrably lower,namely inside"the Donitur greencoloured" series. All the left upper part of "the greencoloured" series as well as "the Donitur aleurite-sandstoneous" series by G.N.Khatiskatsi and A.K.Dertev had been related to the transitional middle-upper Jurassic deposits. As a grounds for the realtion of "the Donitur greencoloured" series to the middle-upper Jurassic age served the lithological resemblence of it with the Baisun series of the South-western offshoots of the Hissar ridge only,the age of which is treated as to be Batian - lower parts of Callovian.

In the Saiḫan-Ishpushtin coal-bearing region the middle Jurassic deposits had been for the first time established in the region of the coaly deposit of the Ishpushta,as it was pointed out before by R.Furon (I923),from the collections of whom T.M.Garis had determined the middle Jurassic flora. The middle Jurassic age of the deposits here had been confirmed later too by the works of V.I.Bratash and others (I96I); G.N.Khatiskatsi and A.K.Dertev and others (I963).

In the Pul-i-Khumrin coal-bearing region the middle Jurassic deposits had been studied also by G.N.Khatiskatsi,A.K.Dertev and others (I963) in the region of the Karkarian coaly deposit. On the grounds of determinations of spora-pollen complexes and remains of flora they singled out here the middle Jurassic deposits with the thickness being 200 m only.

Lithological impersistence of the middle Jurassic deposits and extreamly irregular and in general slight their characteristic by vegetative remains do not provide foundations for an uniform their dissection and for a quite precise parallelization of them on the investigated territory.

In connection with this on considerable areas we single out the only middle division of Jurassic system without more detailed dissection of these deposits;rarely parts of division or small lithological benches typical for limited areas are singling out. The separation of such small lithological subdivisions in the sections of middle Jurassic deposits appeared to be useful in general as it had provided the possibility to correcly approach to their comparetive lithological-facial study when the thickness of sediments is great.

Below a successive description of the middle Jurassic deposits,traced from the West of the investigated territory to the East is adduced.

In the Darra-i-Sufian coal-bearing region in the composition of the middle Jurassic deposits the Shabashek series has been singled out by us,involving the whole stratigraphical volume of the middle division

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of Jurassic deposits, on different areas here the parts of the Shabashe series ("the lower part" and "the upper part"),the Lelaian subseries had been singled out. All these subdivisions here have no a wide distribution or any strict stratigraphical defenition.

The S h a b a s h e k series

The Shabashek series for the first time had been singled out in the region of the Shabashek coaly deposit as a result of the prospecting-exploration works carried out by B.N.Androsov,N.S.Kudryashov and others (I963).

Firstly to the Shabashek series had been related the part of the middle Jurassic section being in the thickness nearly 250 m. only . Later the more detailed study of the middle Jurassic sections had provided us with the possibility to reconsider the situation of the upper Shabashek series in the region of the Shabashek deposit and increase it for approximately I70 m. Therefore,the total thickness of the series in the region of the deposit of Shabashek amounts 450 m.

Stratigraphical volume coinsides with the middle division of the Jurassic system.

The Shabashek series occurs concordantly and only at some places - with a slight washout on the deposits of the Regbulak series of the lower Jurassic and with a clear washout is overlapped by the deposits of the Bashek series of the upper Jurrassic age.

The structure of the series is very monotonous and is representing by itself an irregular alternating of benches of aleurolites,consolidate clays,sandstones,sometimes being with gravell and small pebbles. As a main the interstratification has a flyshoidal character. Among aleurolites and consolidated clays the beds of hard coal with the thickness being from first dozens up to 2.98 m. are met.

The section of the Shabashek series in the region of coaly deposit of Shabashek (fig.27,dr.32) could be illustrated by the following fragment of the constructed here detailed section from the coaly bed No.3 (according to West -No.9) and above up to the coaly bed No.8:

I. Hard coal lustrous bedded dense (bed No.3).....I.6I m.

2. Thin interstratification (the thickness of beds 0.20 up to 0.8 of consolidated clays being of dark-grey colour,often aleuritic,sometimes coaly and then almost black,sandstones of light-grey colour,fine-grained foliated with great amount of vegetative detritus and with imprints of plants and of aleurolite being og greenish-grey colour,often laminated with vegetative detritus. Among the consolidated clays and

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among aleurolites (rarely) sideritic and rarely limonitic small concretions,sometimes concretional interbeds with the thickness up to I-3 cm. of strongly ferruginized sandstones with the thickness up to 0.I5 m. are met. Among the coaly argillites thin lenses (up to I cm.) of lustrous hard coal can be observed ..... I5.00 m.

3. Hard coal lustrous,semi-dull laminated(bed No.4)..... 0.97 m.

4. Interstratification of sandstones of grey colour,being fine-grained laminated with vegetative detritus (along the bedding) and with limonitic concretions(up to 0.I0 m.),aleurolites being foliated with rare ferriferous concretions (up to 0.04 m. in diameter),sometimes with fragments of columns of woods. At the upper part of the section there is a bed of aleuritic coaly consolidated clay with thin (up to I cm.)small lenses of lustrous hard coal..... 6.00 m.

5. Interstratification of sandstones(the thickness of beds is from 0.I0 up to I.00 m.) of grey,light-grey,brownish-grey,fine-grained,sometimes slightly calcareous laminated with vegetative detritus(by bedding) sometimes with ferriferous concretions aleurolites(the thickness is from 0.20 up to I.65 m.), being grey thinbedded sometimes laminated ,sometimes lumpy,micaceous with small vegetative slime,at some places ochreous. Sometimes the beds of consolidated clays,being sometimes coaly,almost black with thin small lenses of lustrous hard coal and with concretional paltes of siderite with the thickness being from I.0 up to 2.0 cm....
..... 29.80 m.

6. Bed of hard coal being lustrous,dull,bedded(bed No.5) ..I.35 m.

7. Interstratification of sandstones(thickness of beds 0.30-2.50m.) being of yellowish-grey colour,unclearly bedded,micaceous,fine-grained with siliceous-clayey cement,of aleurolites being unclearly bedded,shelly micaceous (thickness of beds 0.20-I.75 m.) and of consolidated greenish-grey or dark-grey clays (thickness of beds 0.I0-0.70 m.),sometimes being coaly with thin (up to I cm.) small lenses of lusrous hard coal, with sideritic concretional interbeds,the thickness of which being up to 0.I2 m. At the middle part of the section there are interbeds of clayey siderite with the structure "cone in cone",the thickness being 0.I5 m.....2I.70m.

8. Bed of hard coal being of compound structure (bed No.6);it has been composed by three beds the thickness of which being respectively 0.58;0.85;0.34 m.,divided by consolidated black coaly clays with interbeds of lustrous hard coal,with lenses of aleurolite ..... 7.55 m.

9. Interstratification of aleurolites of greenish-grey colour,unclearly horizontaly laminated,often being with vegetative detritus(by bed-

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ding) with the thickness from 0.30 up to 2.00 m. and of consolidated clays of greenish-grey,grey,sometimes colay with thin (up to 5 cm.) interbeds of lustrous hard coal with rare concretional interbeds of clayey siderite with the thickness up to 0.I5 m.,with rounded concretions being in diameter up to I0 cm. .....I7.20 m.

I0. Bed of hard coal being lusrous,semi-dull laminated with interbeds of consolidated clay,the thickness is up to 0.I5 m.(bed No.7)...
..... 2.50 m.

II. Interstratification of sandstones(thickness of beds from 0.70 up to 5.20 m.) being yellowish-grey fine-grained unclearly laminated, with vegetative detritus(thickness 0.30-I.35 m.) aleurolites being of greenish-grey colou,foliated,sometimes with ferriferous concretions and of consolidated clays (thickness 0.35-0.58 m.) sometimes coaly with lenses of lustrous hard coal,the thickness of which being up to 3 cm. I6.00 m.

I2. Bed of hard coal lustrous,laminated (bed No.8).....I.04 m.

I3. Sandstones yellowish-grey,grey fine-grained unclearly bedded with vegetative slime,with interbeds of aleurolite,being grey horizontaly bedded. At the upper part -there is a concretional interbed of clayey siderite with the thickness being 0.20 m..... 8.00 m.

I4. Interstratification of aleurolites(thickness of beds is from 0.25 up to I.45 m.) being greenish-grey,yellowish-grey,grey,foliated with vegetative detritus and of consolidated clays (thickness of beds 0.I5 up to I.35 m.) being grey with vegetative detritus,sometimes being coaly black with thin small lenses of lustrous hard coal with the thickness of the latter being 3-4 cm.,rare concretional interbeds of clayey siderite with the thickness up to 0.20 m.,rare interbeds of sandstone (thickness 0.50-2.50 m.) being grey,yellowish-grey fine-grained with vegetative detritus. At the upper part of the section there is a small bed of lustrous hard coal with the thickness 0.37 m. ..... 29.60 m.

The thickness of the described part of the section is ..I55.80 m.

In the section of the Shabashek series the ratio of the rocks is the following: sandstones -27%;aleurolites -34%,consolidated clays-33%, hard coal-6%.

In the adduced section the absence of pebbly and gravelly material the heightened content of aleurolites and clays as well as of hard coal are of interest. Abundance of concretional interbeds of siderite and of limonitic concretions,the absence or unclear character of bedding are also important features of this section. From the whole section of the Shabashek series in the region of Shabashek the following vegetative

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remains have been selected: Cladophlebis denticulata Brongn., Cl. schensiensis Phan., Podozamites sp., Cladophlebis sp., Thaumatopteris sp., Cladophledis argutula (Hr.) Font, Dictyophyllum sp., Klukia westi Tacob et Shukla.

The mentioned fossil flora according to the conclusion of T.A.Sikstel and N.M.Loseva who had determined it, testifies to the middle Jurassic age of the country rocks enclosing this flora.

The accumulation of the rocks of the Shabashek series in the region of the deposit is the direct continuation of the sedimentation process, which had begun during the lower Jurassic (The Regbulak series) and took place in the same conditions of the filling of marginal part of the intermontan depression by alluvial-swampy deposits.

The processes of coal-sedimentation during this period had a more intensive character. The Shabashek series in the region of the deposit of Shabashek contains up to 35 beds of hard coal with the thickness being from 0.10 up to 2,98 m., and as it was already pointed out, nearly 6% of the thickness of the section. Hard coal was formed at the expence of vegetative material, which was accumulating both at the place (authochthonically) and (in more less degree) at the expence of the material carried by floods (allochthonically).

As a proof of mixed (autochthoneous-allochthoneous) origin of hard coal in the region of Shabashek is on the one hand the presence of soils and fossil stumps, burialed in vertical position and discovered, for example when driving an inclined mine working by the coaly bed No.7 and by some anouther beds, the presence of numerous delicate parts of plants and relative clearness of coal mass, and the absence in a number of cases of ancient soils, contamination of coal mass by rock interbeds, splinting of beds and lens-like character of their occurrence on the other.

Sedimentations of the Shabashek series are traced quite far beyond the limits of the Shabashek coaly deposit. For example, to the East from the Shabashek they are traced up to the coaly deposit of the Sary-Assia, where they have an alike character, but somewhat more high coal-saturation and somewhat more great content of coarse-fragmental rocks (sandstones) (fig.32, dr.33) in the section. Under the total thickness of the Shabashek series in the region of Sary-Assia being 488 m. for the part of sandstones there is 42,5%, for aleurolites-24.0%, for consolidated clays -25.5%, for hard coal-9%.

Further along to the East in the basin of the Aokhorak river the deposits of middle Jurassic age are apparently represented by somewhat decreased section and are singled out as middle Jurassic deposits with-

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out specification of their stratigraphical volume (fig.32,33 and 34,dr. 35,36 and 37). They occur with conglomerates at the basement of the section on the deposits of Triassic age (dr.37). Their composition does not differ at all from the described in the more western regions deposits. Coal-bearing of these deposits here is not great:only at the lower part of the section the beds with the thickness being up to 0.40 m. are met. The thickness of middle Jurassic deposits in the region of the Aokhorak river dees not exceed 335.0 m. To the West and South-West from the Shabashek the character of the Shabashek series is essentially changed.

For,example,in the region of the Dakhani-Torian coaly deposit as well as in the valley of the Lela,where the coal manifestation of the same name has been discovered the Shabashek series is divided into two lithologically different strata,singled out by as as the lower and the upper parts of the series. Besides it, in the valley of the Lela due to a special lithological character of the lower part of the series it has been singled out as the Lelàian subseries. Correlation of these two part of the series as well as of the Lelaian subseries could be approximate only.

"The L o w e r part" of the Shabashek series in the region of the Dakhani-Torian coaly deposit is singled out by us in the volume of the before singled out by V.I.Bratash and others (I96I) "the Donitur gravellitic-sandstone" series,but without the upper thick sandstones (78.0 m.) which are related by us to the upper part of the Shabashek series section(fig.35.,dr.3I).

The section of"the lower part" of the Shabashek seiries in the region of the Dakhani-Torian coaly deposit is the following(from the bottom):

I. Sandstones of yelowish-grey colour,medium-and coarse-grained with lenses of gravellite,unclearly laminated. At the upper part of the section in the sandstones appear interbeds of aleurolites and argillite: At the roof there is a bed being in the thickness 2.0 m.of heteropebbly conglomerate with pebbles being from I-2 up to 5-8 cm. in diameter. Blocks being in diameter up to I m.(in pebbles - quartzite-like grey sandstones,grey effusives,medium effusives,quartz,black chalcedony,marbled limestones) are often met..... 23.00 m.

2. Interstratification of sandstones(thickness of beds from 0.50 up to I.50 m.) of yellow-grey,grey colour,fine-and medium-laminated and of aleurolites (thickness of beds 2.0-2.5 m.) being of greenish-grey colour,thinlaminated with interbeds of clays,sometimes being coaly with the thickness from 5 up to I0 cm. ..... 39.98 m.

3. Interstratification of sandstones(thickness of beds up to 2.0 m

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being yellow-grey,grey,often with gravelly material of laminated aleurolites (thickness of beds up to I.00-I.50 m.),of greenish-grey laminated and subordinate interbeds of consolidated by grey aleuritic clay (thickness of beds 0.20-0.50 m.)..... 54.45 m.

4. Sandstone yellowish-grey coarse-grained with lenses of gravellite and with fragments of columns of wood,stratified.....3.00 m.

5. Interstratification of sandstones being fine-grained and of aleurolites.The beds of sandstones have the thickness from 0.30 up to 0.40 m.;the latter for aleurolites -0.80-I.00 m.....I4.00 m.

6. Interstratification of sandstones,aleurolites and of subordinated consolidated clays ..... 6.00 m.

7. Sandstones yellowish-grey,cross-bedded ferriferous with stripped "tiger" coloration being from fine-up to coarse-grained,occurring by lens-like beds. At the basement there are lenses of gravellite. At the middle part there are lenses(with the thickness up to 0.I m.) of green-grey aleurolites. By the whole stratum fragments of columns of wood are often met..... 34.70 m.

8. Alternation of beds being in the thickness from I.00 up to 4.30 meters of sandstones being fine-grained,thin-stratified,of aleurolites greenish-grey,lumpy,of consolidated clays being grey,slightly coaly...
..... I3.I0 m.

9. Sandstones greenish-grey,grey medium-grained,unclearly stratified,at some places with vegetative detritus and with fragments of wooden columns.....I4.85 m.

I0. Interstratification of sandstones being yellow-grey fine-grained with cross-bedding(thickness of beds up to I.20 m.) and of aleurolites (thickness of beds 0.40-2.00 m.) being greenish-grey stratified. Clayey sideritic concretional interbeds with the thickness up to 0.20 m. are often met.....29.32 m.

Total thickness of "the lower part" of the Shabashek series in the region of the Dakhani-Torian deposit amounts .....232.4 m.

As it could be seen from the description the characteristic peculiarities of "the lower part" of the Shabashek series in the region of the Dakhani-Tor is the heightened quantity of coarse-terrigeneous rocks-sandstones,gravellites and conglomerates (in sum they amount 60%,aleurolites -29%,clays -II%) as well as complete absence of signs of coal-bearing. Sandstones and gravellites often carry a clear cross bedding of "flood" type.

The described deposits were apparently accumulated in the conditions of a submarine delta of an opened water basin of lake type,to what

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testifies a quite sufficient "elutriation" of the sediments, the presence of cross bedding as well as of lenses of gravelly-pebble material.

Some more to the South-West in the valley ot Lela river tha part of sediments, corresponding by their situation in the section apparently of "the lower part" of the Shabashek series, is represented essentially differently and has been singled out under the name of the Lelaian subseries.

The L e l a i a n subseries is well exposed near the village of Lela. It is distinquished on the locality for its dark almost black colour and for a very monotonous structure. The predominant rocks here are consolidated dark, almost black clays; polymictic sandstones and aleurolites form interbeds between the clays and compose subordinated benches, mainly at the basement of the series.

The section of the Lelaian subseries near the village of Roshahi-Bolo (fig.36, dr.34) is the following (from the bottom):

I. Clays consolidated black fragmental with interbeds of still more black coaly consolidated clays with thin lenses of lustrous hard coal (up to ǂ mm.) with rare interbeds of greenish-grey polymictic fine-grained sandstones, slightly calcareous (thickness of interbeds up to 0.20-0.30 m.). Aleurolites and sadstones contain concretions of siderite...
..... 52.30 m.

2. Sandstone grey, greenish-grey fine-grained, dense stratified..
..... 6.50 m.

3. Clays consolidated dark-grey up to black, with rare interbeds of fine-grained sandstones with the thickness up to 2.50 m. Consolidated clays contain concretions of siderite and small vegetative detritus. Cross bedding is apparent in sandstones..... 84.00 m.

4. Sandstones light-grey, greenish-grey dense thinplaty with thin interbeds of dark-greyaleurolites ..... 24.8 0 m.

5. Interstratification of consolidated clays, aleurolites and sandstones being fine-grained of dark-grey, greenish-grey colour. Sandstones have thickness up to I.00 m..... 99.00 m.

6. Sandstones light-grey, greenish-grey thin-stratified, medium-grained polymictic slightly calcareous..... I9.50 m.

7. Clays consolidated dark-grey sometimes black coaly, micaceous with rare interbeds of sandstones and aleurolites .....209.20 m.

8. Sandstones light-grey, greenish-grey thin-bedded polymictic fine- and medium-grained with rare interbeds of dark-grey aleurolites with the thickness up to I2.50 m. and of consolidated clays up to 8.0 m.....
.....I23.60 m.

Total thickness of the Lelaian subseries is ..... 6I8.00 m.

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On the rocks of the Lelaian subseries the rocks of "the upper part" of the Shabashek series are occurring.

The ratio between the composing the series rocks is the following: sandstones-30%, aleurolites - 25%, consolidated clays -45%. Characteristic feature of the subseries is almost complete absence of beds of coal, sharp predominance of dark-grey, almost black consolidated clays, slight amount of small vegetative detritus, the presence of thin unclearly pronounced cross bedding in aleurolites and in sandstones. The inumerated features apparently testify to the sedimentation of theses deposits in an opened water basin of lake or lagoon type. The described deposits are apparently should be parallelized with "the lower part" of the Shabashek series, described in the region of the coaly deposit of the Dakhani-Tor.

" The U p p er part " of the Shabashek series is clearly distinguished in the region of the same Dakhani-Torian coaly deposit. It has been decribed before by V.I.Bratash and others (I96I) under the name of "the Donitur greencoloured " series with the total thickness being 480 m.

Conserning this part of the section there is no a common opinion. G.N.Khatiskatsi, A.K.Dertev and others(I963) consider the lower part of this series, being in the thickness 2I0-220 m. to be middle Jurassic, the upper parts they relate to the transitional deposits of Batian-Callovian stages, correlating them, as it was pointed out before, with the Baisun series of the South-western offshoots of the Gissar.

As a result of the carried out investigations "the upper part" of the Shabashek series including into it the whole "Donitur greencoloured series, is related by us to the middle Jurassic age. These series are overlapped with a washout by a very characteristic "tiger" sandstones, traced on a considerable area of this region and occurring at the basement of the Bashek series of the upper Jurassic.

"The upper part" of the Shabashek series is not regular by its colour and lithology.

At the area of coaly deposit of the Dakhani-Tor it is represented by interstratification of sandstones, consolidated clays and aleurolites with very rare lenses of gravellite; fragments of wood are often met here. Pebbly material is practically absent. Grey-ot brown-green colour of aleurolites and clays, providing the series a green in general colur is characteristic.

In the region of the Dakhani-Torian coaly deposit "the upper part" of the Shabashek series(fig.27, dr.32) has the following structure(from the bottom):

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I. Sandstone brownish-grey fine and medium-grained, cross bedded or massive with lenses of gravellite and rare small pebbles of white quartz and black chalcedony(rare), it is protruding in the form of bench..65.0m.

2. Interstratification of sandstones, aleurolites and shistose consolidated clays, clays are the predominant, aleurolites are in less quantity - they form frequent interbeds with the thickness being 0.20-0.40m. sandstones are still less often met. At the lower part of the section there are several interbeds of black coaly clays with small lenses of lustrous hard coal. At the basement of the section there is a bed of hard coal with the thickness up to 23 cm. ..... 76.00 m.

3. Interstratification of sandstones being medium-grained, of aleurolites, consolidated clays and rare interbeds of fime-and medium-grained sandstones. The beds reach the thickness up to 3 meters .....48.80 m.

4. Sandstone brownish, brown-grey fine-and medium-grained with lenses of coarse-grained sandstone anf gravellite. Sandstones contain the imprints of plants of poor preservation.....I3.40 m.

5. Sandstones brown, brown-grey, fallow-grey, medium-and coarse-grained with fragments of wooden columns, with lenses of gravellites being in the thickness up to I.3 m. At the lower part of the section-there are interbeds of consolidated clays with the thickness up to I.50 m.... .....I3.60 m.

6. Thin interstratification of aleurolites being green-brown, of consolidated clays of dark-grey colour and or rare interbeds of grey fine-grained sandstones. At the lower part of the section -interstratification of grey and dark-grey consolidated clays with small lenses of sooty hard coal with the thickness up to 5 cm., containing vegetative carbonificated remains..... 42.50 m.

7. Sandstone brownish-fallow up to brown-grey being medium-grained, at some places a cross bedding is noticeable..... 6.70 m.

8. Interstratification of greenish-brown and greenish-grey consolidated clays, being ofyen aleuritic and of aleurolites; rare beds of fine-grained sandstones with the thickness 0.30-0.50 m. Among aleurolites and clays a small vegetative detritus is often met ..... 35.20 m.

9. Sandstone greenish-grey medium-grained bedded. By the surface of bedding - vegetative detritus..... 3.20 m.

I0. Interstratification (thickness of beds 0.40-0.60 m.) of aleurolites being of greenish-brown colour with small vegetative detritus and of fine-grained green-grey sandstones ..... 6.I0 m.

II. Interstratification of grey, greenish-grey colour, being sometimes aleuritic consolidated clays and of aleurolites of greenish-brown colo-

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ur being clayey and micaceous,often with vegetative detritus by the surfaces of bedding;rare interbeds of brown-grey medium-grained sandstones. Aleurolites and sandstones are protruding "by ridges". The thickness of beds ranges from 0.30-0.50 up to I.20-I.40 m. ..... 32.50 m.

I2. Interstratification of consolidated clays being grey and dark-grey in colour,schistose with carbonificated vegetative detritus and of brownish-green schistose consolidated clays with numerous imprints of pelecipodae. From this part of the section out of the collections of A.K.Dertev and E.A.Repman the following fossils have been determined: Pseudocardinia cf. Jeniseica Mart.,Ps.cf.Nuclaeformis Tschern.,Ps.cf.elongatiformis Tschern.,Ps.(?) sp. ind. ..... 8.80 m.

I3. Interstratification of sandstones being of brownish-grey colour, fine-grained micaceous unclearly bedded and of aleurolites being greenish brown,micaceous. Fragments of wooden columns,carbonificated vegetative detritus are met.....5.00 m.

I4. Consolidated clay,of greenish-grey colour foliated ...4.00 m.

I5. Sandstones greenish-grey fine-grained micaceous with small carbonificated vegetative detritus,with rare imprints of plants;rare lenses of consolidated green-grey clays with concretions of limonitizated markasite are enclosed in the rocks ..... I4.80 m.

I6. Sandstones brown-grey fine-and medium-grained with interbeds of green-grey aleurolites and consolidated clays at the lower part of the section ..... 20.00 m.

The total thickness of "the upper part" of the Shabashek series in the region of the Dakhanitur amounts ..... 398.60 m.

The ratio of different rocks in the section is as follows: sandstones -44%,aleurolites-24%,consolidated clays - 32%.

The adduced fresh-water fauna,when describing the section, according to the conclusion of V.I.Ivanov is alike to the complexes of the fresh-water fauna from the middle Jurassic deposits of the Northern Fergana and the Taurkyr.

From the basement and the middle part of "the upper part" of the Shabashek series in the region of the Dakhani-Tor the remains of fossil flora have been collected among which T.A.Sikstel and N.M.Loseva have determined the following: Cladophlebis argutula(Heer.),Font.,Podozamites sp.,Phlebopteris sp.,Cladophlebis sp.,Coniopteris sp.,Nelsconia aff., orientalis Heer.,Ginkgodium nathrstii Lok.

The described forms,espesially the presence of the Coniopteris and Cladophlebis genera also testify to the middle Jurassic(Batian-Baioss)

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age of the deposits under description.

The coal-bearing of "the upper part" of the Shabashek series in the region of the Dakhani-Tor is not great and is marked at its basement only, where benches of coaly clays, often being with lenses of lustrous hard coal with the thickness of beds being from first up to I5 rarely up to 23 cm. met.

The accumulation of sediments of "the upper part" of the Shabashek series took place apparently in the conditions of the same delta, which was mentioned when describing "the lower part" of this series. However, the conditions of sedimentation had been somewhat changed. The delta apparently having advanced forward for a considerable distance turned into shoal, it was periodically dryed out and at some places, especially during the initial stages it was swamped.

I5 km. to the South-West from the coaly deposit of Dakhani-Tor, in the region of the village of Lela "the upper part" of the Shabashek series is represented by an interstratification of dark consolidated clays and subordinated to them sandstones and aleurolites. In the section the clays are the predominant providing the series grey or greenish-grey tint Coal-saturation is noticeably increased.

At the mouth of the sai Lela (the left slope) the section of "the upper part" of the Shabashek series (fig.36, dr.34) has the following structure (from the bottom):

I. Clays consolidated dark-grey up to black, fragmental with interbeds of green-grey dense aleurolites (thickness is from 0.20 up to 2.00 m and rarely of sandstones polymictic yellowish-grey, often with gravelly material with the thickness up to 6.00 m. Coaly varieties of clays contain small lenses of lustrous hard coal (2-3 cm.). Sandstones and aleurolites contain small vegetative detritus. At the middle part of the section the coaly clays contain a bed of lustrous hard coal with the thickness up to I.00 m. .....9I.90 m.

From this bed the following remains of flora have been collected: Brachyphyllum sp., Nilssonia jagnobensis Sixt., Equisetites Ferganensis Sew.

2. Clays consolidated dark-grey, greenish-grey thin-bedded, fat. Sometimes they are coaly with vegetative detritus. At the middle part-there is an interbed with the thickness being nearly 3.0 m. of coarse-grained light-grey sandstones. At the basement-there is a bed of hard coal of compound structure (interstratification of hard coal and of coaly clay, interbeds being 2-3 cm. each.). At the upper part of the section there is a bed of hard coal of compound structure with the thickness being

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from 0.78 up to I.60 m..... 57.50 m.

3. Sandstone grey fine - and medium-grained polymictic,slightly calcareous,unclearly bedded..... 34.00 m.

4. Sandstone grey,dark-grey medium-and coarse-grained with lenses of gravellite and with small well rounded pebbles composed by white quartz,black chalcedony and limestone.....I5.50 m.

5. Clay consolidated dark-grey,sometimes coaly and almost black with lenses of lustrous hard coal with the thickness up to 3 cm. At the upper part of the section there is a bed of lustrous hard cola of compound structure with the thickness from I.22 up to I.55 m. ..... I4.00 m.

6. Alternating aleurolites being of greenish-grey colour and of grey fine-grained sandstones. In the latter an unclear bedding is noticeable ..... 42.50 m.

7. Consolidated clays being light-grey,greenish-grey,colay,black, platy with thin interbeds of light-grey aleurolites. At the basement - there is a bed of hard coal of compound structure with the thickness being I.) m. ..... I9.30 m.

8. Sandstone grey medium-grained slightly calcareous with thin interbeds of gravellites,the thickness of which being up to 0.I0 m..I9.90m

9. Consolidated clays of grey,green-grey colour with thin interbeds of aleurolites(up to 5 cm.) and of sandstones(up to I.0 m.); rare interbeds of coaly clays of black colour. At the middle part -there is a bed of hard coal of compound structure with the thickness being from I.0 up to I.50 m. ..... 49.40 m.

From this bed the reamins of flora: Cladotheca cf.undaus (L.ct H) Halle., Elatides curvifolia (Dunk.) Noth., Cladophlebis shepsiensis have been selected.

The thickness of "the upper part" of the Shabashek series in the region of the Lela village amounts ..... 344.00 m.

The ratio of the rocks composing the section is as follows: sandstones -30%, aleurolites- I5%,consolidated clays - 53%,hard coal-2%.

The adduced when describing the section remains of flora according to the conclusion of T.A.Sikstel and N.M.Loseva who had determined them confirm the middle Jurassic age of the enclosing rocks.

In the direction to the West (near the village of Roshagi-Bola) (fig.36,dr.34-a) the deposits of "the upper part" of the Shabashek series being of the same thickness contain more great amount of clayey and clay-coaly material and more great number of coal beds (up to 9 beds with the thickness being from 0.20 up to 2.80 m.).

The accumulation of the deposits under description took place in the

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already typical alluvial-swampy conditions,being created here due to more intensive advancing of delta and to swamping of the periodically drained part of it.

The Shabashek series within the limits ofthe Darra-i-Sufian region in general differs by the heightened coal-saturation. To this series a number of beds of hard coal (up to I4 pcs.) is confined being of workable thickness (the deposits of Shabashek,Harmak western,Harmak eastern, Sary Assiya). At the same time,for example in the region of the Dakhani-Torian coaly deposit there is practically no one bed of hard coal. At the other places the coal-bearing is the only upper part of it (the deposit of Lela). Such an irregularity in the coal-saturation of the deposits is connected with different conditions of the deposits sedimentation.

The thickness of the Shabashek series ranges from 450 up to 962 m.

The lithology in general,as it could be seen from the adduced sections,is very monotonous,at some places with evident features of rhytmicity. The rhythms usually do not represent a successive repeateness of beds of similar rocks and thicknesses. Every rhythm begins with sandstones (sometimes with gravell and pebbles) and finished by interstratification of aleurolites and consolidated clays,coaly clays sometimes with lenses of hard coal. Some constituent parts of rhythms are not always present and are not constant in the thickness. Rhythms in general have thickness from first meters up to I0 (Shabashek) or up to 20-30 m.(Sary-Assya). Often the rhythmicity simply difficult to follow and the section has the character of complicated interstratification(Lela).

The heightened coal-bearing of the Shabashek series is often marked at the very these places where rhythmicity of the section is more clearly pronounced. Such a connection is not casual one and is conditioned by the definite situation of the areas of coal accumulation relatively the source of removal of terrigeneous material and of the depression,filled by sediments. The accumulation of sediments of the Shabashek series in t the Darra-i-Sufian region took place in a comparetively small intermontane erosional-tectonic depression,partly being accupyed by fresh water basin of a lake type (or of freshed lagoon) and being intensively filled by terrigeneous material,supplyed by rivers. The near shore parts of this freshwater basin,especially at the interdelta spaces,duringthe periods of drainage were intensively swamping and overgrowned with vegetation, which provided the material for coal-accumulation. Filling of the depression by alluvial material is quite sufficeintly explains the lithological diversity of the observed here terrigeneous deposits,fastly replacing each other on a comparetively short intervals and,in particular,the spa-

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tial and temporal irregularity of coal-accumulation facies.(Migration of facies of coal-accumulation).

In the Saihan-Ishpushtin coal-bearing region the deposits of middle Jurassic age are dissected by us into three parts: the lower, the middle and the upper. These parts have been singled out in accordance to lithological and colour features and have a local importance only. They are not always expressed by the whole area of the region and practically have no strictly pronounced boundaries. From the point of view of their coal-bearing the singled out "parts" of the section are not equivalent. For example, "the lower part" of the section here is a productive one and in the region of Ishpushtin coaly deposits contains beds(lenses) of hard coal being of industrial value; the middle and upper parts are practically coalless.

The l o w e r p a r t " of middle Jurassic age begins with a bed of basal conglomerates, occurring with a washout on the underlying lower Jurassic deposits. Above the interstratification of beds and benches of aleurolites, sandstones, consolidated clays and coaly clays with beds of hard coal, the thickness of which being from 0.I0 up to 2.6 m. is observed Rare beds of fine-and medium-pebbly conglomerate are observed here too. At the upper part of the section the alternation of aleurolites, sandstones; being fine-and medium-pebbly conglomerates and consolidated greenish-grey aleuritic clays, sometimes black coaly clays with thin small lenses of lustrous hard coal are the predominant here. The general tint of the bench is dark green-grey, due to which the bench is well distinguished on the locality from the underlying stratum of Lias age as well as from the abovelying deposits, being also more lighter coloured related to the middle Jurassic age.

The section of "the lower part" of the middle division of Jurassic age in the valley of the Ishpushta river(fig.28, dr.40) is the following (from the bottom):

I. Conglomerate fine-and medium-pebbly composed by medium-rounded pebbles of Paleozoic rocks - sandstones, black hornfels, white quartz (up to I0%), marbles, metamorphic schists. Cement is loose calcareous-clayey sandy. Conglomerate contains lenses of greenish-grey fine-grained sandstone with concretions of oxidized markasite with the size up to 3 cm. in diameter .....I3.8 m.

2. Interstratification of fine-grained brownish-yellow, grey sandstone and of grey aleuritic clay, often with lenses of sooty coal. At the middle part of the section - there is a compound bed of hard coal being in the thickness I.37 m., composed by interstratificating sandstones, black

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coaly clay and hard coal (pure hard coal -0.32 m.). At the upper part of the section-there is another second bed of hard coal,also being of compound structure(pure hard coal-0.26 m.). The bed is well distinctive for its light yellow-brown colour.....I8.40 m.

3. Aleurolite grey,greenish-grey,micaceous at some places ferruginized with interbeds up to 0.20 m. in thickness of fine-grained sandstone,above by the section it is transitioning into thin interstratification of the same aleurolites and dark-grey aleuritic clays,sometimes being with small lenses of sooty coal being in the thickness 0.05-0.I0 m. At the upper part of the section there is a bed of fine-grained light-grey sandstone(I.5 m.),being sometimes red ..... 28.90 m.

4. Bed of hard coal being of compound structure with the thickness 2.I2 m.(pure hard coal -I.04 m.-the exploitating bed),above - interstratification of aleurolite being greenish-grey,of consolidated dark-grey clay and rarely of sandstone being fine-grained and of yellow-brown colour. Below the beds have the thickness up to 3 m.,above - from 0.I up to 0.60 m. ..... I3.60 m.

5. Conglomerate medium - and fine-pebbly,dense (quartz up to 50%), black hornfel I5-20%,metamorphic rock -30-35%).....7.00 m.

6. Irregular interstratification of sandstone being brownish-grey with small pebble,of aleurolite being greenish-grey micaceous,of consolidated clay being dark-grey,sometimes with lenses of lustrous coal with the thickness up to 7 cm. Below the beds have the thickness 2-3 m.,above -interstratification becomes more thin - 0.I-0.5 m. 4 m. from the roof there is a bed of hard coal being of compound structure with the thickness 2.08 m. (pure coal -0.57 m.) ..... 34.70 m.

7. Conglomerate medium-pebbly with rare coarse pebble,with rare interbeds of sandstone. Cement is sandy-clayey not very dense.. 22.00 m.

8. Clay green-grey lumpy aleuritic with interbeds of green-grey aleurolite with the thickness being 0.2 m. ..... 8.40 m.

9. Conglomerate analogical to that in the bed "7" ,. 3.30 m.

I0. Below-interstratification of clays of greenish-grey colour,lumpy aleuritic,and of platy aleurolites;above besides clays and aleurolites beds of sandstone being fine-grained and micaceous are met....33.00 m.

II. Conglomerate fine- and medium-pebbly at some places with coarse pebble;above -ferruginization in the form of crusts..... 8.00 m.

I2. Aleurolite green-grey micaceous lumpy. .....I0.00 m.

I3. Conglomerate fine-pebbly with lenses of medium-pebbly and coarse-pebbly conglomerate. In the middle part of the section-there are interbeds of grey-green aleurolite,and of grey sandstone..... I7.50 m.

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I4. Aleurolite green-grey lumpy with interbeds of fine-grained sandstone with the thickness from 0.20 up to I.5 m. ..... 27.30 m.

I5. Clay green-grey aleuritic lumpy,at some places coaly with thin lenses of lustrous coal (up to I cm.) ,..... 20.00 m.

The total thickness of "the lower part" of the middle Jurassic section in the region of the Ishpushta amounts ..... . 266.00 m.

The ratio of the rocks is as follows: conglomerate -20%, sandstone--I5%,aleurolite -33%, clay - 3I%,hard coal -0.8%.

The deposits of the lower part of Dogger of the Ishpushtin region have the typical alluvial-swampy appearence and have been apparently sedimented in a wide intermontane valley,intensively being filled by coarse-fragmental material. Simultaneously with this,at separate its parts,during the definite moments of time swamps had been formed abundant with vegetation which provided the material for the accumulation of hard coal.

"The M i d d l e p a r t" of the middle Jurassic age begins with conglomerates,above which occur interstratificating sandstones,aleurolites and clays. The general tint of the deposits is green-grey,more light than that of the lower part of the section.

In the Ishpushtin valley "the middle part" section of the middle Jurassic age (fig.28.,dr.40) has the following structure(from the bottom

I. Conglomerate fine- and medium-pebbly with sandy-clay dense cement Above -there are interbeds of sandstone being up to 0.50 m. in the thickness.....I9.00 m.

2. Clays green-grey lumpy,at some places foliated micaceous,at some places dark coaly(beds with the thickness up to I.0 m.) with thin small lenses of lustrous hard coal (up to 4 cm.). Interbeds of green-grey fine-grained sandstone (with the thickness up to I.5 m.) or of aleurolite are met. Just here an interbed with the thickness up to 0.60 m. of strongly clayey limestone has been met..... 46.I0 m.

3. Conglomerate analogical to that in the bed "I" .... 6.00 m.

4. Interstratification of clays,aleurolites and sandstones,analogical to bed "2". Sandstones are somewhat predominant and form beds being in the thickness 0.30-0.80 m. in every I-3 m. Sandst ones of brown colour are protruding "by ridges" .....I0I.I m.

Total thickness of "the middle part" of the middle Jurassic in the region of the Ishpushta amounts ..... I72.20 m.

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" The U p p e r p a r t " of the middle Jurassic also begins with conglomerates above which occur interstratificating sandstones, aleurolites and clays with rare benches of conglomerates. By the colour the upper part is alike the undrlying "middle part". From the abovelying deposits of the upper Jurassic it differs by more dark grey-green colour and by less quantity of conglomerates.

In the valley of the Ishpushta the section of "the upper part of the middle Jurassic (fig.28, dr.40) has the following structure (from the bottom):

I. Conglomerate fine- and medium-pebbly with rare lenses of sandstone .....I0.00 m.

2. Interstratification of green-grey micaceous aleurolites with rare interbeds of aleuritic clays (thickness being 0.20-0,40 m.) and of sandstones being inequigranular loose quartzy .....2I.30 m.

3. Conglomerate medium-pebbly, at some places with a great amount of coarse pebbles and small boulders with the size of the latter up to 0.20 meters in the diameter.....34.00 m.

4. Aleurolite green-grey with interbeds of sandstone being fine-grained ..... 8.50 m.

5. Conglomerate analogical to that in the bed "3", there are several beds of sandstone with the thickness being from I up to 2 m. .. 30.00 m.

6. Interstratification of clay lumpy, at some places foliated, at some places black coaly with thin small lenses (up to I cm,) of lustrous coal of aleurolite being greenish-grey platy and of sandstone being dark-grey polymictic with small pebble. The beds of clay have the thickness from I up to 4 m., the beds of aleurolite -0.5-I.0 m., rarely upto 3 m...I27.I m

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Total thickness of "the upper part" of the middle Jurassic in the region of Ishpushta amounts ..... 230.90 m.

The ratio of different rocks in "the middle part " of the middle Jurassic section is as follows: conglomerates -I3%, sandstones -20%, aleurolites -20%, clays - 47%, hard coal -practically absent; in "the upper part" respectively as follows: 3I%, 23%, 23% and 23%, that is the increasing of the conglomerates' role and the decreasing of the role of clays.

"The Middle part" and "the upper part" of the middle Jurassic age in the Saihan-Ishpushtin coal-bearing region are mapped together under the index ; their total thickness amounts 403.00 m.

To the North-East from the village of Ishpushta at the mouth of the Halak sai (fig.28, dr.4I) the total thickness of "the middle part" and of the "upper part" of the middle Jurassic section is decreased and amounts

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237.0 meters only.In the South-western direction,near the village of Doabi-Mekhzarin (fig.28,dr.39) the thickness is incresed up to 505 m., but further along to the South in the basin of the Saihan river it is sharply descresed (fig.28,dr.38).

The total summary thickness of the middle Jurassic deposits reasches the biggest maltiutde in the region of the Doabi-Mekhzarin,amounting 820.0 meters.

In this region the section contains less quantity of conglomeratic rocks (only nearly I0-I3%) and some more of aleurolites and clays (including coaly ones),and apparently corresponds to the Central part of the depression.

In the region of coaly deposit of Ishpushta as well as near the Doabi-Mekhzarin by the whole section of the middle Jurassic age numerous remains of flora have beeen collected out of which T.A.Sikstel and N.M.Loseva (during different time) determined the following forms: Ctachyetaxus sp., Ctenus sp., Elatides sp.,Cladophelebis haiburnensis L. et H.,Equisetites gigantus Bur.,Coniopteris hymenophylloides (Brongn.) Sew.,Nilssonia sp., Klukia westi Tac and Shukla, Eberacia labifolia (Phil.) Thom. Cladophlebis argutula (Heer.) Font., Cl. sp.,Coniopteris sp.,Equisefites sp.,Pagiophyllum curvifolium (Dunk.),Nilssonia vittaeformis Prin.

The inumerated flora is widely distributed in the middle division of Jurassic age in the Central Asia of the USSR.

In the Pul-i-Khumrinn coal-bearing region the deposits of the middle division of Jurassic system have a limited distribution and are known in the region of coaly deposits of Karkar and Dudkash as well as to the East from them in the region of coaly deposit of Nakhrin. The total area of the outcrops of these deposits here does not exceed 45 sq,km.,for all this the greatest(nearly 37 sq.km.) is established in the region of Nakhrin;in the same region the middle Jurassic deposits have apparently complete and the most thick section.

The middle Jurassic deposits are represented by interstratification of sandstones and consolidated often coaly clays with vegetative remains and lenses of hard coal. In the section observed more thick being from 5 up to I0 m. benches of sandstones with small and middle pebbles and rarely (in the region of Nakhrin) -benches of medium and coarse-pebbly conglomerate composed by medium and well rounded pebbles of Paleozoic rocks. Sandstones are arkose,or polymictic often have a coarse cross bedding.

Beds of hard coal have been marked in the region of coaly deposit of Nakhrin at the middle part ofthe section only.

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The section of the middle Jurassic deposits in the valley of the Dudkash river(fig.37,dr,42) has the following structure(from the bottom;

I. Sandstones pinkish-brown arkose fine-grained with numerous small and medium pebbles of quartz and of black siliceous rocks. Cross bedding of river type (angles up to 30°) is well observed.....42.00 m.

2. Clays consolidated greenish-grey lumpy at some places schistose with rare interbeds of sandstones,the thickness being 0.I0-o.I5 m.; small vegetative remains,detritus.....42.50 m.

3. Sandstone light yellowish-brown arkose medium-up to coarse-grained,at some places with gravell,small and medium pebbles which form lenses sometimes. Pebbles are composed by quartz of white colour,black hornfel,brown chalcedony. Cement is clayey-siliceous dense,sandy. Imprints of stems and columns of woods are often met. Coarse cross bedding is apparent ..... 34.30 m.

4. Interstratification of aleurolites and consolidated clays. Aleurolites are of brown colour being of lumpy structure and are the predominant in the section. Consolidated clays are of greenish-grey colour,schistose with vegetative detritus..... 32.50 m.

5. Interstratification of sandstones being arkose and fine-grained of aleurolites green-grey lumpy,of consolidated clays of dark-grey colour with clayey selvages,saturated with vegetative detritus. The thickness of beds is from 0.20 up to I.5 m. ..... I3.80 m.

6. Clay consolidated red-brown aleuritic with fragments of undrlying rocks. The boundary with the undrlying rocks is unclearly pronounced, with pockets (it may me a crust of weathering); with the lying above conglomerates. The boundary is sharp ..... 45.90 m.

Total thickness of the middle Jurassic deposits in the region of Dudkush amounts .....I70.00 m.

The middle Jurassic age of the deposits is established on the ground of their occurrence with a washout on the underlying deposits,containing the remains of lower Jurassic deposits and spora-pollen complex peculiar to transitional beds from the Lias to the Dogger stages.

From the described deposits A.K.Dertev indicates the following flora Taeniopteris sp.,Pterophyllum sp. which do not contradict the middle Jurassic age of the enclosing them deposits.

The described deposits carry a feature of the accumulation in the conditions of periodically drained and swamped delta and are related to alluvial-swampy deposits.

In the region of coaly deposit of Dudkash the deposits of middle di-

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vision of Jurassic age and with an unconformity occur on the deposits of Lias and are with a washout overlapped by coarse-terrigeneous deposits of Upper Jurassic age, Due to this washout in the southern direction they are quickly thinned and in the region of Sanhach they are completely omissed from the section.

Further along to the North-East in the region of the Nakhrin village the middle Jurassic deposits are practically not divided from the lower Jurassic for complicated conditions of occurrence. Only in separate sections,for example,near the coaly deposit of the same name the deposits of Dogger could be conditionally singled out. Here they are represented by quite monotonous greenish-grey stratum of alternating consolidated clays,sometimes of coaly aleurolites and sandstones often being with lenses of gravellite and fine-pebbly conglomerate;at the basement of the section benches of medium-and coarse-pebbly conglomerate are marked; at the middle part of the section coaly beds of industrial thickness are met.

The section of middle Jurassic,constructed in the region of coaly deposit of Nakhrin is subdivided into four benches: ("d","e","f" and "q" every one of which begins with more or less thick conglomerates,gravellites or sandstones. By the area these benches are badly traced.

The structure of the section in the region adjacent to the coaly deposit of Nakhrin (fig.29,dr.44) is as follows(from the bottom):

I. Conglomerates green-grey polymictic medium-and coarse-pebbly with interbeds and lenses of coarse-and medium-grained sandstones. Cement is sandy clayey-siliceous. ..... 27.00 m.

2. Interstratification of consolidated grey clays,sometimes coaly and of fine-grained greenθgrey sandstones ..... 20.00 m.

3. Conglomerates analogical to that of the bed "I" .... 25.00 m.

4. Clays consolidated,often coaly with interbeds of aleurolites and lenses of lustrous coal with the thickness up to 0.05 m. with vegetative detritus ..... 35.00 m.

5. Sandstone greenish-grey medium-grained..... 2.00 m.

6. Clay consolidated,analogical to that of the bed"4"..50.00 m.

7. Sandstone analogical to that of the bed "5"..... 2.00 m.

8. Clay consolidated,analogical to that of the bed "4"..20.0 m.

9. Sandstone analogical to that of the bed "5".....20.00 m.

I0. Clays consolidated greenish-grey with interbeds of aleurolite, micaceous,sometimes coaly .....20.00 m.

II. Sandstones with lenses of gravellite and of fine-pebbly conglomerate ..... 50.00 m.

I2. Consolidated grey clays,in separate beds coaly abundant with

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vegetative detritus,with vegetative remains. Clays contain numerous thin interbeds of grey platy aleurolites,rare beds of sandstones being polymictic greenish-grey with the thickness from 0.50 up to I0.0 m. ..
....I65.00 m.

I3. Clay consolidated grey often being coaly black with interbeds of green-grey platy,sometimes lumpy micaceous aleurolite. At the basement there are two beds of hard coal being lustrous with the thickness of 0.90 and 0.75 m. At the middle part there are two more beds with the thickness 4.40 and I.00 m. ..... 55.00 m.

I4. Clays consolidated with interbeds of aleurolites and sandstones
.....25.00 m.

I5. Interstratification of sandstones coarse-grained cross-bedded with lenses of gravellites being dark-grey,greenish-grey. Among aleurolites there are concretions of siderite..... 30.00 m.

I6. Interstratification of aleurolites(thickness of beds 0.70-2.00m) of sandstones fine-grained(thickness of beds is 0.50-I.00 m.) and of clays often being coaly(thickness of beds is 0.30-2.00 m.)..20.00 m.

I7. Sandstone coarse-grained transitioning into gravellite with rare lenses (thickness up to 0.50-0.80 m.) of dark aleurolite ..I5.00 m.

I8. Interstratification of aleurolites and argillites..I0.00 m.

I9. Sandstone fine-grained greenish-grey..... 6.00 m.

20. Clays consolidated grey,interstratificating with green-grey aleurolite and rare interbeds of coarse-grained sandstone with the thickness up to I.00 m. At the middle part of the section among the consolidated coaly clays there is an interbed of lustrous hard coal with the thickness being up to 0.I0 m. ..... 40.00 m.

2I. Sandstone green-grey fine-grained..... 5.00 m.

22. Clay grey up to black,consolidated coaly..... 3.00 m.

23. Sandstone analogical to that of the bed"2I".....3.00 m.

24. Interstratification of consolidated clays and aleurolites. At the upper part of the section there are interbeds of medium-and coarse-grained sandstones,sometimes transitioning into gravellites,the thickness of which being 0.50-0.80 m..... 55.00 m.

25. Sandstones green-grey fine-grained ..... I0.00 m.

Above the section is cut by tectonic fracture.

The total apparent thickness of the middle Jurassic deposits amounts ..... 7I3.00 m.

The ratio of the rocks in the section is as follows: conglomerate--9-I0%, sandstone-25%,aleurolite-25%, clay-40%,hard coal - I,0%.

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From the bed "I3" (the bench "d") of the described section the following remains offlora : Sagenopteris phillipsi (Brongn.),Cladophlebis sp., Nilssonia ex gr. vittaeformis Pryn.,Coniopteris latifolia Brick., Podozamites sp.,Phoenicopsis sp.,Coniopteris ex gr. furssenkoi Pryn., Coniopteris sp. have been selected,which according to the conclusion of T.A.Sikstel and N.M.Loseva indicate to the middle Jurassic age of the enclosing them stratum.

The accumulation of the described deposits apparently took place in the conditions of a vast overground delta,periodically being overgrowthed and swamped.

In the C h a l - N a m a k a b i a n coal-bearing region the deposits of the middle Jurassic age occur in extreamely complicated tectonic conditions,which do not allow to construct a continuous section and to exactly estimate their thickness. In the region of coaly manifestations of Chal,Siakh-Darra,Darra-i-Kolon and Zamburak the only parts of the section could be observed,represented here by alternating of benches of consolidated clays and sandstones (fig.30,dr.45)46)

Consolidated clays of grey colour,sometimes almost black coaly with thin interbeds of aleurolites being green-grey,brownish-grey with vegetative detritus and of fine-grained sandstones being greenish-grey uncleарly bedded. The beds being in the thickness from 0.I0 up to 0.80 m,rarely up to I-2 m.,compose the benches with the thickness being from 5-I0 up to 50 meters.

Sandstones medium-and coarse-grained being of light brownish-grey colour,polymictic,often with an admixture of tuffogeneous material,or arkose with gravell and small pebble with unclear diagonal coarse bedding with the thickness from 2-3 up to 5-8 m. often divide the benches of sandy-clay composition.

Among the coaly consolidated clays and aleurolites at the middle part of the stratum there are I-2 ,rarely 3 beds of lustrous hard coal with the thickness from 0.05 up to 0.35 m. are marked. At the upper part of the section also among the consolidated clays there are two beds of hard coal with the thickness being 0.20 and 0.60 m. marked.

The thickness of middle Jurassic deposits in the Chal-Namakabian region can be estimated as to be 700-850 m. To the South it apparently is decreased. For example,in the valleys of Pitowak and Bazarak (fig.30, dr.47) middle Jurassic deposits contain more great quantity of coarse-terrigeneous material(sandstones,conglomerates) lithologically being united with the lower Jurassic ones and together with them have the thickness not more than 400 m.

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From the middle and upper parts of middle Jurassic section of the regions of Chal,Siakh-Darra and the Darra-i-Kolon the following fossil remains of flora have been selected: Equisetites ex gr. gigantus Bur., Neocalomites ex gr. issykulensis Tur.,Anomazamites poljanskii Imin., Podozamites lanceolatus L.et H.,Pityophyllum nordenskioldii Heer.

According to the conclusion of T.A.Sikstel and N.M.Loseva this flora indicates to middle Jurassic age of the enclosing it rocks.

The sediments of middle Jurassic age in the northern part of the Chal-Namakabian region are more poor by coarse-fragmental material (conglomerates are almost absent) and contain a plenty of consolidated clays and aleurolites with small vegetative detritus. The mentioned fact indicates apparently to the more great remoteness of the area from the sources of removal of terrigeneous material. The sedimentation of the deposits took apparently place in the conditions of lake-swampy plain,being intensively filled by alluvial and proluvo-alluvial formations. In the southern direction,as it was pointed out above,the quantity of coarse-fragmental material is gradually increasing,the quantity of clays being less and less and together with this the quantity of beds and lenses of hard coal as well as their thickness are decreased.

The deposits of middle division of Jurassic system within the territory being interesting to us are in general related to the formations of typically continental origin,accumulated in the conditions of erosional-tectonic intermontane depressions.

By the conditions of forming they are related to alluvial-poluvial-swampy,alluvial-lake and swampy formations. A continuous warping of depressions and pulsating character of tectonic movements lead to the accumulation of very thick strata of theses sediments and conditioned their flysoidal character.

The U p p e r division

The deposits of upper division of Jurassic age on the investigated territory within various parts of it have different character and have been studied with different detailness.

For instance,within the Darra-i-Sufian and Saiḫan-Ishpushtin coal-bearing regions the upper Jurassic deposits have been represented by terrigeneous sediments of continental origin and have been very poorly studied.

G.N.Khatiskatsi,A.K.Dertev and others(I963) in the region of the Dakhani-Tor on the grounds of lithological correlation with the sections of the Gisarian ridge offshoots single out the deposits of lower parts of

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Callovian stage to which the upper part of "the Donitur greencoloured" series of V.I.Bratash had been related,as well as the upper parts of Titonian stage,divided by a washout.

In this region the Bashekian series has been singled out by us,involving the whole section of the upper Jurassic system apparently involving the upper parts of this series (Titonian stage)

To the South-East in the Saihan-Ishpushtin coal-bearing region (in the region of the villages of Doabi-Mekhzarin and Ishpushta as well as at the left bank of the Saihan river) by the same investigators the only upper horizons of Titonian stage are supposedly singled out,to which the lower parts of "the Red Grit" series had been related by them.

As a result of our investigations here supposedly the lower parts of Callovian stage (bench "2" and the lower parts of the bench II) with a washout overlapped by Neokom-Aptian redcoloured deposits("the Red Grit" have been singled out. The more upper horizons of the upper Jurassic section are supposed to be washed out during the Pre Cretaceous time.

In the Pul-i-Khumrin and Chal-Namakabian coal-bearing regions the upper deposits are represented by terrigeneous and chemogenic deposits of foreshore-marine lagoon and less of typical marine origin . They have been studied comparetively in detailes. Here in the region of the Pul-i-Khumri village (near the coaly deposits of Karkar and Dudkush) for the first time the section of the upper Jurassic age had been investigated by R.Furon and L.Rosse (I954) who the collected by them fauna related to Bat-Baisssian stages.

Later this section had been studied by V.I.Bratash,V.V.Pechnikov, Ju.S. Shakhijanov,V.O.Cherkesov and others (I962), G.N.Khatiskatsi, A.K.Dertev and others (I963) by whom here on the grounds of paleontological and lithological features allthe stage subdivisions of Upper division of Jurassic age have been singled out.

The upper Jurassic deposits had been singled out by G.N.Khatiskatsi and A.K.Dertev in the region of the pass of Chal as well,in the same facies and subdivisions as in the region of Karkara.

Our investigations in the Pul-i-Khumrin and Chal-Namakabian coal-bearing regions did not add any essential changes into the sratigraphical scheme adopted by the previous investigators,excluding the more detailed dissection of the foreshore-marine deposits of Callowian stage. Among the latter on the grounds of lithological and colour features four benches have been singled out by us (the bench I - basal;the benches II and III, and the bench IV).

Below the successive description of upper Jurassic deposits in the

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stratigraphical sequence is adduced.

The C a l l o v i a n stage

The deposits of Callovian stage have a quite wide distribution in the Pul-i-Khumrin and Chal-Namakabian coal-bearing regions. The lower boundary of Callovian stage is established here by the transgressive superimposition of this deposits on the deposits of middle division of Jurassic system;the upper one is drawn by the basement of the bench of carbonaceous rocks (limestones and marbles) being with the fauna of Oxfordian stage. The whole steatum of the deposits of Callovian stage has been dissected into four benches according to lithological features (from the bottom: the benches I,II,III,IV). The lower and the middle parts of the section (the benches I.II,and III) have a foreshore-continental or at some places a lagoon character and do not contain fauna;the age of this part of the section as Calloviah is supposed to be conditionally. At the upper part of the section (the bench IV) at a number of places a marine fauna was met.

In the Saihan-Ishpushtin coal-bearing region the Callovian stage (the benches I and II) have been singled out conditionally in the composition of the continental terrigeneous stratum.

In the Darra-i-Sufian coal-bearing region as a main the upper division of Jurassic system,represented by continental formations is being singled out; it could be probably only supposed that the lower parts of this section correspond to Callovian stage,which is not yet proved here.

In the Pul-i-Khumrin coal-bearing region the most complete section of Callovian stage in the region of the coaly deposit of Dudkash is observed. Here on a washed out surface of middle Jurassic deposits with a slight angular (7-8°) unconformity the series being different by its lithological composition,corresponding to transgressive-regressive regime of marine basin at the beginning of Upper Jurassic epoch is superimposed. Here the following four benches going from the bottom to the top have been singled out (fig.37,dr.42):

B e n c h No.I (basal)

Conglobreccias grading into conglomerate. The rock is composed of medium- poor and unrounded at all fragments of white quartz,metamorphic micaceous schists,quartzite-like sandstones. Fragments of quartz are the predominant. The size of fragments is different up to IO , rarely up to 20 cm. in diameter. Sorting is not obvious. Cwment is sandy-clayey strongly micaceous. Among conglobreccias and conglomerates lenses with the

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thickness up to 2 cm. of micaceous sandy-clayey rock,gravellite and sandstones of light-grey or greenish-grey colour rarely of red-brown colour. In the upper part of the bench the material becomes more finely fragmental;sandstones,gravellites and clays become to be the predominant. In sandstones a cross bedding is apparent being of floods type. In the middle part of the bench there are green-grey aleurolites and sandy clays with thin rare lenses (up to I-2 cm.) of sooty coal marked. The thickness of the bench is .....I38.40 m.

The b e n c h No.II

Clays reddish-brown,greenish-grey;sandy micaceous;at the lower part-with lumps of white and pink gypsum with rare interbeds of yellow-brown micaceous sandstone,gravellite; at the upper part- there is a greenish-brown aleurolite being micaceous calcareous with remains of valves of Cuculaea sp.,Modiolus cf.gibbosa Sow. and with vegetative remains. On these aleurolites with a washout occurs a partycoloured bench with the thickness up to I0 m. composed of consolidated micaceous clays of yellow-brown,greenish,grey-pink,green-grey,grey,olive-green colour with conglomerate interbeds being fine- and medium-pebbly and with separate coarse pebbles and boulders (with the size of the latter being up to 0.40 m. in diameter),composed of the underlying greenish-grey aleurolite with the same fauna. At the upper part of this partycoloured bench there are three raproched beds of sooty coal with the thickness 0.I5;0.I0 and 0.I0 m. marked. Beside them numerous bun-shaped limonitic (primary apparently being sideritic) concretions,silicificated fragments of woods,unclear imprints of plants,vegetative detritus are met here. In the located at this place inclined workings these beds form a united bed of coal being of complicated structure with the thickness more than 3.0 m.(the workable bed of the Dudkash and the Karkar). The thickness of the bench II is.... .... I04.6 m.

The b e n c h No.III

Below-grey consolidated clays above by the section grading into yellow-brown calcareous aleurolites and sandstones. Above-there is a bed of yellow bedded limestone being organogeneous,at some places pseudoooolitic with the thickness being 6.0 m. The whole bench is abundant of remains of fauna. From this bench by V.I.Kuznetsov the following fossils have been determined (from the upper part): Pholodomia murchisoni Sow.,Mytilus aff. perpicatus Etall., Astarte aff. pulla Roem., Myophorella sp.,Astarte cf. incolita Rep.,Modiolus sp.,Lopha (?) sp.,Goniomyaa sp.,Homomya sp.,Homomya aff. choffati Borissiak, Exogyra sp.,Rhynchonella sp.; from the lower

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part (collection of A.K.Dertev): Distichoceras cf. bispinatum Zieten. Inoperma af.perplicata Etallon., Phylodomia murchisoni Sow., Ph. Suberal tata Kras., Precervites sp.,Inoprrna aff.perlicata Etallon.,Lima sp.,Panope sp.

The thickness of the bench III is ..... 23.00 m.

The b e n c h No.IV

Clays consolidated calcareous grey,dark-grey,yellowish-pale,greenish-yellow in colour. At the middle part and especially at the upper one in them interbeds of bright-green,bright-red and red-violet colours with the thickness 0.60-0.70 m. are appearing. By the whole bench rare beds of shell limestones with the thickness from 0.60 up to 5.0 m. are observed. From the limestones remains of fauna,among which V.I.Kuznetsov had determined the following: Lima (Plagiostoma) aff. Rurganchensis Rep., Isognoman aff. caucasica Pcel.,Isognoman sp.;from the very this rock (from hillside waste) Ju.S.Shakhijanov indicates Perisphinctes sp.nov. (alike to P.cf.biplex Sow.).

The thickness of the bench No.IV is .....47.00 m.

Total thickness of Callovian stage in the section of the Dudkash amounts .....3I3.00 m.

The age of the described deposits is proved quite definitely. For example,ammonite of genus Distichoceras is known from Callovian-Oxford deposits of the European part of the USSR and the genus Distichoceras bispinatum is widely known from the Callovian stage of the CentralAsia. Genus Procerites is known from Batian-Callovian deposits of Europe,the European part of the USSR, Caucasus,etc.

The mentioned genera of pelecipodae are characteristic for Callovian and Callovian-Oxford stages of Tajikistan and Turkmenistan. G.N.Khatiskatsi (I963) analysing the fauna in the region of the Dudkash considers that it has been characteristic predominantly for the middle and upper parts of Callovian stage.

The lower boundary of Callovian stage in the region of the Dudkash in accordance with G.N.Khatiskatsi,A.K.Dertev and others (I963) we have drawn by the basement of the I st bench,which with a washout occurs on the deposits of middle Jurassic age or on the Pul-i-Khumrin series of Upper Triassic age. This washout is quite widely marked in another regions of the territory being of interest to us,as well as beyond its limits.

The upper boundary of Callovian stage in the section of the Dudkash on the grounds of a sharp lithological change of calcareous clays of

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the Callovian stage by limestones and clayey limestones, being already related to the Oxford stage is drawn.

The section of Callovian stage in the main has transgressive character and is characterized by natural change of facies being from continental (the bench I) and foreshore-lagoon (the benches II and III) up to typically marine ones (the bench IV).

The deposits of the bench I have foreshore, possibly alluvial-proluvial origin. The accumulation of these deposits differed by intensive supply of the local material, to what testifies its poor roundness as well as absence of sorting (at the lower part of the section).

The deposits of the benches II and III have been apparently accumulated in the conditions of regressive-transgressive regime, to what the presence of beds with lumps of gypsum and that with lenses of hard coal, divided by terrigeneous rocks with pelecipodae fauna testify.

The deposits of the bench IV in the region of Dudkush have without doubt a marine origin to what testifies for example the presence of cephalopodic fauna.

In the C h a l - N a m a k a b i a n coal bearing region to the North-East from the coaly deposit of Dudkush approximately at the distance of I00 km. the deposits of Callovian stage are fixed quite claarly on a vast territory, mainly by thick basal sandy-conglomerate beds, occurring on underlying middle- or upper Triassic deposits with a noticeable washout. For all this, in the regions located to the North (Chal, Roshag, etc.) the deposits of the bench I of Callovian age occur on the deposits of middle Jurassic age, and in the South (the middle part of the Namakab and Kishakton rivers)-directly on the effusives of upper Triassic age. The thickness of the deposits of Callovian age in these regions at some places exceeds I 000 meters.

The most northern section of Callovian deposits in the region of the coaly deposit of Roshag (fig.38, dr.49) has the following structure (from the bottom):

I. The bench No.I (Basal)

I. Conglomerate fine- and medium-pebbly, sometimes up to coarse-pebbly, of greenish-brown colour, composed of medium-and well-rounded pebbles of effusives, metamorphic rocks, quartzite-like sandstones, rarely of marbles. Cement is dense sandy clayey-siliceous. Inside conglomerated lenses and seams of gravellite, rarely of coarse sandstone with pebbles are marked; bedding is unclear..... 65.00 m.

2. Interstratification of clays consolidated dark-grey, sandy of grey-brown aleurolites being platy with vegetative detritus, rarely of

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sandstones being polymictic fine-grained. Separate beds of clays are strongly enriched by coaly substance, contain two-three lenses of hard coal with the thickness being from 0.05 up to 0.30 m. ..... 40.00 m.

3. Conglomerates analogical to those described in the bench "I". At some places they contain fine rubbly material. .....II5.00 m

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Total thickness of the bench"I" is .....220.00 m.

The bench II (greycoloured)

I. Interstratification of consolidated dark-grey aleuritic clays, of aleurolites being greenish-brown, brown-grey platy and of rare beds of fine-grained polymictiv sandstone. The beds have thickness from 0.I0 up to 2-3 m. Often, especially at the basement beds of lustrous hard coal, reaching the thickness up to I.2 m. (the deposit of Roshag), concretions of siderite and limonite, thin plates (up to 0.20 m.) of marsh ore, vegetative detritus are marked..... 200.00 m.

2. Conglomerates greenish-grey, grey, fine-and medium-pebbly with an admixture of coarse pebbles, with lenses of gravellites and sandstones; often lenses of aleurolites and consolidated clays ..... 50.00 m.

3. Interstratification of grey consolidated clays being aleurolitic aleurolites being brownish-grey platy micaceous with vegetative detritus and of rare beds of brownish-grey polymictic sandstone being fine-and medium-grained. The thickness of the beds ranges from parts up to I.5-3m Sometimes benches of coaly almost black clay with thin lenses of lustrous hard coal are met. .....I80.00 m.

The bench III (greencoloured)

I. Conglomerate fine-and medium-pebbly with an admixture of coarse pebble with separate lenses of coarse-pebbly conglomerate and with small boulders. The pebbles are composed of quartzite-like sandstone, effusive rocks, less - of metamorphic rocks and marbled limestones, pebbles of granitoids are rarely marked; cement is sandy clayey-siliceous greenish-brown, sometimes green, apparently at the expence of the admixture of effusive material. Bedding is coarse, unclear ..... I60.00 m.

2. Irregular interstratification of aleurolites being platy, rarely of polymictic micaceous green-grey, sometimes brown-green and of consolidated aleuritic green-grey clays. Rare beds of greenish-grey, sometimes fine-grained sandstones with pebbles, grading into fine-pebbly conglomerates with an admixture of coarse pebbles. The thickness of the beds is from 0.I0-0.I5 up to 2-3 m. .....I80.00 m.

Total thickness of the bench III is .....340.00 m.

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The bench IV(partycoloured)

I. Interstratification of red-brown and bright-green aleurolites and of consolidated aleuritic clays,rarely - of fine-grained sandstones, being often calcareous. Green rocks are the predominant,the red ones (up to violet-red) occur in the former in the form of interbeds (they usually colouring vast spaces of slopes). Aleurolites possess a horizontal lamination sometimes being intercrossed,irregular of swell type. Frequent scolites are observed here. Total thickness of the bench IV is .....80.00 m.

Total thickness of the benches I,II,III and IV of Callovian stage in the region of the village of Roshag is .....I070.00 m.

On the deposits of the bench IV which is most probably correlated with the bench No.IV of the section in the region of the coaly deposit of Dudkash occur marly limestones (above quickly grading into massive limestones) with abundant fauna of the middle-upper Callovian stage and of the Oxford one. In the described terrigeneous deposits of Callovian stage (the benches I,II,III and IV) remains of flora and fauna are not found,which could testify to the age of these deposits. A washout at their basement,being correlated with the analogical washout at the basement of Callovian stage in the section of the coaly deposit of the Dudkash as well as the Callovian fauna from the upper parts of the section allow to relate the whole stratum of the described terrigeneous rocks to the Callovian stage and most probably to the lower-middle Callovian.

In the more southern regions (Chal-Namakab,Bazarak,etc.) the common character of the deposits and thicknesses of separate benches are in general persistant.

In the Chal-Namakabian coal-bearing region with the deposits of Callowian stage a number of coal-manifestations,mainly confined to the definite stratigraphical levels is connected. There are two such levels The first(lower) is confined to the bench I,namely to beds of aleurolites and consolidated clays,occurring in the middle part of the bench among conglomerates and sandstones. Usually they are small in scale coal manifestations,represented by lenses and beds of lustrous hard coal with the thickness being from 0.05 up to 0.30 m. As examples could serve the coal manifestations of the Saed,Sangilyashl,etc.

The second(upper) level is confined to the basement of the bench "II" These coal manifestations are more great both in the thickness of coaly beds (up to 3.0 m.) and in the area of their distribution. As examples are the coal manifestations of the Roshag,Namakab,Kishakton,Chal-II,etc

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Callovian stage (?) supposed

The deposits of supposedly Callovian age are singled out in the Saihan - Ishpushtin coaly region. Here on the deposits of "middle-upper" parts of middle Jurassic section ($J_{2\ m+s}$) with not always clearly pronounced washout occur series of conglomerates, gravellites, sandstones, aleurolites and consolidated clays being sometimes coaly with thin small lenses of hard coal.

The section of the deposits under description in the region of coaly deposit of the Ishpushta (fig.28, dr.40) has the following structure (from the bottom):

I. Conglomerate green-grey fine-and medium-pebbly with an admixture of coarse pebble; pebbles are composed of effusives, quartzite-like sandstones, metamorphic rocks (rare) etc.; rare interbeds and lenses of gravellites and sandstones, rare beds of green-grey platy aleurolite with the thickness from 0.I0 up to 0.70 m. are marked. Cement is loose sandy-clayey..... 60.20 m.

2. Interstratification of clays consolidated, grey foliated with vegetative remains with thin lenses (up to I mm.) of lustrous hard coal, of aleurolites being greenish-grey platy or foliated and of lens-like interbeds of grey-brown polymictic sandstone. Thickness of the beds of clay is from I.0 up to 4.0 m., the latter of aleurolites is from 0.5 up to I.0, rarely up to 2.0 m., thickness of sandstone's beds is from 0.I0 up to I.50, rarely up to 3.0 m..... 29.80 m.

3. Conglomerates analogical to those in the bed "I". Coarse pebble is often predominant, as well as small boulders; cement is loose ..209.0 m.

4. Aleurolites greenish-grey clayey (the beds with the thickness being I.0-2.5 m.), sandstones fine-grained polymictic with gravelly material and small pebbles of white quartz and black hornfel (thickness is from 0.20 up to I.0 m.); consolidated lumpy aleuritic clays, sometimes coaly with thin small lenses (up to 5 mm.) of lustrous hard coal are rarely met. .....II4.00 m.

Total thickness is ..... 4I3.00 m.

The deposits of the supposed Callovian(?) stage in the region of Ishpushta differ from the whole underlying part for more great amount of congolomerates, also for more great their coarseness and slight cementation. Correlating the described section with the section of the Chal-Namakabian region one can see somewhat resemblence in lithological character of the rocks, due to which the lower three beds of the Ishpushtin section could be correlated with the bench "I" of the Pul-i-Khumrin

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and Chal-Namakabian coal-bearing regions,and the upper bed of the Ishpushtin section respectively with the basement of the bench II.

From the upper bed of the Ishpushtin section in the region of the Doabi-Mekhzarin village A.K.Dertev (I962) and later we in the region of the Ishpushta collected the following remains of flora: Coniopteris humenophylloides (Brongn.) Sew.,Pagiophyllum curvifolium (Dunk.),Nilssonia vittaeformis Pryn, Klukia Nesti Tae and Shukla,Eboracia lobifolia (Ph (Phil.) Thom.,Ptilophyllum cutchense Old. et Mor.,Taeniopteris sp.

These forms according to the conclusion of T.A.Sikstel do not contradict the upper Jurassic age and are completely correlated with the complex,established in the Shuraba (The USSR,southern Fergana) for the lower parts of Jurassic age,though more poor apparenly at the expence of arid climate of Afghanistam.

The described deposits had been accumulating in a closed intermontane erosional-tectonic depression,being intensively filled by proluvial-alluvial deposits,removed here by numerous floods. In the central parts of this depression small swamped areas were episodically appearing in which aleurolites and coaly clays with lenses of hard coal had been accumulating.

O x f o r d i a n s t a g e

The deposits of Oxfordian stage were singled out only in the western part of the Pul-i-Khumrin coal-bearing region near coaly deposits of the Karkar and Dudkash.

The most complete and well exposed section of these deposits is known in the region of coaly deposit of the Dudkash (fig.37,dr.42) where it has been represented by an united massive bench of limestones,forming a cliff,elomgated above the mines of the Dudkasin and Karkarian coaly deposits in meridional direction.

Limestones with sharp boundary are superimposed on the underlying grey argillites of Callovian stage and also sharply but generally concordantly are overlapped by clayey-aleurolitic deposits of the Kimmerij-Titonain stages.

Limestones of Oxfordian stage at the basement of the section are represented by clayey varieties with thin interbeds (thickness 0.I - 0.2 meters) of greenish calcareous aleurolites (basal bench with the thicknes being nearly 2-2.5 m.). Above lie aphanitic fine-grained bedded limestones with interbeds of lumpy slightly clayey varieties. At the middle part of the section there are several lens-like beds of dolomitizated limestones;at the upper part of the section they are more abundant. The most

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upper parts of the section are composed of thinnest grey dense limestones. The thickness of limestones is 30.00 m.

According to the data of G.N.Khatiskatsi,A.K.Dertev and others(I963) the thickness of these limestones ranges from 20.5 to the South from the Dudkash up to 44.00 m. to the North from it.

Fauna is met at the basement of the limestones only. From this part of the section by us as well as by the previous investigators the following forms have been selected: Campotenectes cf.lens Sow.,C.aff.virgunensis Bav., Modiolus sp.,Hamomya chaffati Borissiak, Lima sp.,Myopholas sp., Liostrea sp.,Chamys sp.,Pholadomya murchisoni Sow.,Gresslia sp.

From the middle part of the section: Plegiocidaris sp.

According to the conclusion of V.I.Kuznetsov,who determined this fauna,it is typical for Oxfordian deposits of Tajikistan.

The Callovian-Oxfordian stages,undissected

The undissected deposits of Callovian-Oxfordian stages have been singled out in the Chal-Namakabian as well as in the eastern part of the Pul-i-Khumrian regions,where they are proved by the finds of fossil organic remains.

In the Chal-Namakabian coal-bearing region everywhere on the party-coloured bench of Callovian stage (bench IV) concordantly occur the facialy irregular stratum of limestones,aleurolites,sandstones,aleuritic clays and of subordinated gypsums,related on the grounds of the determination of numerous remains to Callovian-Oxfordian stages.

In the North of the region,to the North-East from the salty-stone deposit of the Namakab near the village of Roshag (fig.38.dr.49) the section of undissected Callovian-Oxfordian deposits has the following structure (from the bottom):

I. Marl of grey colour,dense with remains of fauna: Anomia affganica sp.nov.,(In coll.),Thracia sp. ind.,Exogyra nana Sowerby, Camptonectes ((Camptochlamys) tachnensis Repman sp.,Camptonectes sp. ind.,"Zeilleria" bucculenta Sow.,"Zeilleria" cf.bucculenta Sow.,Kingena cf. punjabica Sahni.,Aulacothyris gulafaraensis (Moiss,),Kutchithyris Jooraensis (Kitch.),Kingena punjabia Sahni.,Plagiostoma karakulense Andreeva, Plagiostoma cubanense Pcelincev, Plagiostoma sp.,ind.,Camptonectes (Camptochlamys) kurganchensis Repman msp.,Camptonectes sp.ind. .. ..I4.50 m.

2. Aleurolite marly with interbeds of grey lumpy marl.. I5.00 m.
3. Limestone yellow marly at the lower part more dense.. 7.00 m.
4. Aleurolite bedded green-grey and red .....I0.00 m.

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5. Limestone grey dense at the upper part contains yellowish marly interbeds with the thickness 0.50-0.80 m. and numerous remains of fauna: Isocardium sp. ind.,Plesiocyprina(?) sp. ind., Bureiomya sp.ind,Bureiomya sp.nov.,Plagiostoma Lumida Roemer, Modiolus cf.imbricatus Sowerby, Camptonectes (Camptochlamys) kurganchensis Repman msp.,Aulacothyris guldaraensis (Moiss.) Kutchithyris jooraensis(Kitch.) .....25.00 m.

6. Clay of grey colour marly lumpy ..... I.00 m.

7. Aleurolite bedded green,grey,red.....40.00 m.

8. Limestone grey,dense finegrained with Pholodomya ovolum Agassiz ..... 4.00 m.

9. Aleurolites green-grey,grey and red with lenses of sandy gypsum,bedded ..... 22.00 m.

I0. Limestone grey,dense finegrained ..... 2.50 m.

II. Aleurolite green-grey,grey and red;seams with the thickness 0.50-I.00 m. .... 6.00 m.

I2. Limestone grey with shell-like fracture and with marly interbeds in the upper part of the section;from this limestone the following remains of fauna have been collected: Aulacothyris guldaraensis(Moiss.) Zeilleria cf. bucculenta Sow.,Camptonectes sp.ind. .....25.00 m.

I3. Argillite foliated aleuritic ..... 2. 00 m.

I4. Aleurolite red with interbeds of finegrained red-brown sandstone ..... 20.00 m.

I5. Argillite grey aleuritic ..... I.50 m.

I6. Limestone grey dense platy ..... 6.50 m.

I7. Gypsum white,at some places clayey..... 3. 00 m.

I8. Aleurolite grey yellowish;from it Nerinea ex gr. gemmulata Pcelineev has been collected..... 4.00 m.

I9. Gypsum white,grey,laminated .....I.00 m.

20. Aleurolite red with interbeds of finegrained sandstone and gypsum ..... 22.00 m.

The thickness of Callovian-Oxfordian deposits in the Chal-Namakabian region amounts . ... 220.00 m.

The collected by the section remains of fossil fauna according to the conclusion of T.F.Andreeva,N.D.Jushina,V.N.Ovcharenko and V.I.Kuznetsov who had determined it, has the interval of distribution from upper Callovian up to Oxfordian stage inclusive; Nurinea gemmulata are met in Kimmerijian stage as well.

To the South from the salty-stone deposit of the Namakab,at the left slope of the same name valley the upper part of the section of Callovian-

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Oxfordian deposits is represented by dense platy limestones interstratificating with violet-red and green coloured aleurolites and clays. From these limestones the following numerous remains of fossil fauna have been collected: Protocardina concinna Buch.,Liostrea cf.acuminata Sowerby, Modiolus separates Repman.,Modiolus sp. ind.,Falcimytilus cf. parvus Roemer, Astarte asperanta Repman msp.,Camptonectes (Camptochlamys) tachtensis Repman msp.,Plestocyprina(?) gissarensis Repman msp., Plesiocyprina sp. ind., Gervillia sp. ind.

The enumerated fauna according to the conclusion of T.F.Andreeva and N.D.Jushchina who had determined it,is typical for Oxfordian deposits of Tajikistan. An absence of Callovian forms is a characteristic feature for these deposits. It is possible that it is connected with the fact that the deposits to the South from the salty-stone deposit of Namakab correspond to more high horizons of Callovian-Oxfordian section,being non-characterized by fauna in the region of the Roshag village.

To the South,for example, in the region of the interfluve of the Zamburak-Namakab rivers(fig.36,dr.dr. 46,47) the section of the deposits of the same age has another structure. Here on a partycoloured bench of Callovian stage (the bench IV) the following rocks with conformity occur:

I. Limestones marly dark-grey with remains offfauna,interstratificating with grey marly aleurolites and argillites of foliated structure. At the upper part of the section there are interbeds of shell-detrital limestone with the thickness 0.05-10.0 m. There are remains of fauna: Burmirhynchia dattai Buckm.,Kutchithyris aurata(Kitch.),Pseudolimea duplicata Sowerby,Exogyra nana Sowerby,Gervilla sp. ind. ....35.00 m.

2. Limestones light-grey thick-bedded up to massive,now aphanitic with shell-like fracture,now granular calcitizated. An apparent thickness is .....150.00 m.

To the South-West these limestones(the bed No.2) have more great thickness,reaching according to approximate calculation 500 m.

The adduced above fauna(the first two forms),according to the conclusion of V.N.Ovcharenko has the interval of distribution of upper Battian-lower Calloviam. At the same time a great thickness of the limestones provides a basement to consider them not only Callovian ,but in a considerable part as Oxfordian ones,though there were not yet found any remains of fauna,which could confirm this conclusion.

The described deposits of Callovian-Oxfordian age had apparently sedimented in the conditions of an island sea,abundant of vast lagoons. The sediments of Callovian-Oxfordian stages of the salty-stone deposit of the Namakab being represented by alternating of limestones,dolomites,

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aleurolites,sandstones,clays,being sometimes contaminated by gypsum, and of gypsums (at the upper part) represent by themselves a typical lagoon facies. At the same time,thick or coarsely bedded limestones,developed in the region of the interfluve area of the Zamburak-Namakab rivers,are the products of a sea deposits. These limestones are possibly in a considerable their part being reefogeneous,to what testifies their massiveness and sharp ranging of the thickness at short distances.

In the eastern part of the Pul-i-Khumrin region the Oxfordian-Callovian undissected deposits have been established in the region of the Nakhrin village(fig.29,dr.44). In this region the section has the following structure (from the bottom)(the section is not complete,at the lower its part cutted by a washout):

I. Limestone grey organogeneous-fragmental with inclusions of numerous gravell grains of quartz .....I5.00 m.

2. Clays red with interbeds of sandstones and aleurolites of green colour;in the latter the remains of fossilfauna: Pholadomya ovulum Agassiz, Exogyra nana Sowerby, Mytilus aff.perplicatus Etall.,Modiolus sp. have been collected. ..... I2.00 m.

3. Sandstones green coarse-grained grading into gravellites..... ..... I0.00 m.

4. Interstratification of aleurolites of green colour and of clays being of red colour ..... I2.00 m.

5. Sandstones green medium-grained up to coarse-grained,calcareous ..... I0.00 m.

6. Clays brown-red with interbeds of clays being of bright-green colour..... 8.00 m.

7. Limestones grey dense with remains of fauna: Lopha sp.(aff.pulligera Goldf.),Chlamys sp.,Lobothyris sp. ..... 3.00 m.

8. A leurolites grey calcareous ..... I0.00 m.

9. Limestones grey brown,yellowish organogeneous-fragmental with interbeds of yellow,soft clayey limestones (the thickness up to I m.); at the lower part of limestones organic remains: Lobothyris sp.,Astarte sp.,Lopha sp.(aff.pulligera Goldf.),Chlamys sp. have been collected... ..... 35.00 m.

Apparent thickness by the section ..... II5.00 m.

Above lie partycoloured gypsum-bearing deposits,which we relate to Kimmerij-Titonian (?) ones. In the described section the fauna,collected from the lower its part according to the conclusion of V.I.Kuznetsov testifies to Callovian age of these deposits. The fauna from the

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upper parts of the section(the beds 7 and 9) is apparently Oxfordian. It could be apparently supposed that the lower part of the section up to the 6 th. bed inclusively,could has been the Callovian,correlated with the Callovian stage of the Karkar and Dudkash. The abovelying limestones and aleurolites (the beds 7 and 9) are of Oxfordian age. However, the sections of these deposits in the region of the Nakhrin are of waning type and being in complicated conditions what is together with an inedequate quantity of organic remains does not allow with a sufficient probability to make such a dissection either in the section or on the map.

The K i m m e r i j - T i t o n i a n (?) s t a g e s undissected

The deposits of Kimmerij-Titonian(?) stages have been trustworthly established in the north-eastern part of the investigated territory,in the Pul-i-Khumrian and Chal-Namakabian coal-bearing regions,where they in general have a limited distribution. Total area of their outcrops amounts not more than 30.0sq.km. The main feature of these deposits in the mentioned above regions is the presence of chemogeneous formations-of gypsum and rarely of rock salt.

In the Saihan-Ishpushtin coal-bearing region the deposits of Kimmeri Titonian stages(?) are probably absent.

In the Darra-i-Sufian cola-bearing region the Kimmerij-Titonian deposits have been supposed in the composition of the singled out by us deposits of the Bashekian series of the upper division of Jurassic age, about what it will be mentioned when describing the Bashekian series of the upper division of Jurassic system.

In the Pul-i-Khumrian coal-bearing region the most complete section of the Kimmerij-Titonian(?) deposits is known in the region of coaly deposits of the Dudkash and Karkar.

This section here had been studied before by O.V.Cherkasov,V.I.Bratash, C.V.Egupov,V.V.Pechnikov,Ju.S. SHakhijanov and others(I96I,I964) and later by G.N.Khatiskatsi, A.K.Dertev and others(I963).

V.I.Bratash singles out here the Guliobian series, encl osed between two surfaces of unconformity: at the basement - with the Oxfordian(or with Oxford-Kimmerijian) deposits,at the roof - with Neokomian-Aptian ones. The Guliobian series is subdivided by V.I.Bratash into two subseries: "redcoloured" and ""partycoloured gypsumbearing". In the region of the Karkar and Dudkash "the redcoloured series" is apparently absent,and "the partycoloured gypsum-bearing" one has the thickness of 239 m. It is containing numerous fauna of the Oxford-Kimmerijian and of the Titonian agess.

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G.N.Khatiskatsi,A.K.Dertev and others(I963) do not share the opinion of V.I.Bratash and consider the part of the section,occurring directly above the limestones of Oxfordian stage being in the thickness I7I-I96 m and of Oxford-Kimmerijian age adducing as a proof for this some quantities of paleontalogical determinations of organic remains with the interval of distribution of Oxford-Kimmerij. The above lying stratum of gypsums and anhydrites with subordinated aleurolites and clays the total thickness of which being 56.5-63,5 m. the above mentioned authors relate to Titonian(?) age without any paleontalogical proofs for it. Total thickness of the deposits occurring above the Oxfordian limestones in the region of the Karkar and Dudkash is apprised by them as to be 227.5-259.5 m.-259.5 m.

According to our data in the region of the Dudkash (fig.38,dr.42) directly on massive Oxfordian limestones apparently with a small washout the following rocks are occurring:

I. Clays red-brown argillite-like,alternating with grey-blue ones; above them-there is a bed of grey dolomitic limestones being in the thickness 2 meters,above which there lie aleurolites brown-red micaceous with interbeds (up to 0.I0 m.) of light grey-blue fine-grained dolomitic sandstone and pure dolomite with the thickness up to 0.8 m. Still above lie the same brown-red clays at the upper parts saturated with lumps (2-8 cm.) of pink gypsum .....I9.50 m.

2. Dolomite light-grey with greenish tint with small lumps of gypsum ..... 4.00 m.

3. Interstratification of saturated by gypsum brown-red lumpy clays, micaceous foliated clays and of bluish-grey aleurolites with the thickness of beds from 0.I0 up to 0.60 m. 5 m. from the basement- there is a bed of loose white gypsum with the thickness 0.60 m. ..... 32.00 m.

4. Limestone grey,often dolomitic dense with numerous remains of fauna which is difficult for determination..... 5.50 m.

5. Clays grey-green and red-brown(the predominant) in some beds being strongly saturated by gypsum in the form of small lenses,interbeds and small lumps. Besides it at the lower part - there is a number of beds of yellowish or almost white gypsum with the thickness from 0.20 up to 0.60 m.,divided by bluish-grey dolomitic aleurolites. In the middle part - aleurolites of red-brown colour micaceous protruding in a form of a bench up to I.5 m. ..... 46.00 m.

6. Interstratification of dolomites bluish-grey,of sandy dolomites being of greenish-grey colour(thickness of beds 0.60-I.50 m.) and of clays being red-brown in colour with lenses and lumps of gypsum .....
.....I8.00 m.

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7. Interstratification of clays and aleurolites,sometimes being sandy of red-brown(the predominant) and bluish-grey colour. The rocks are saturated by gypsum, lumps and beds of gypsum with the thickness up to i.0 m. are often met. At the upper part of the bench there are two beds of white dense gypsum with the thickness up to 2.0 m. each,divided by gypsum-dolomitic sandstone of bluish-grey colour with the thickness 3.0 m. ..... 66.40 m.

8. Gypsums at the lower part being grey,greenish,spotty clayey; at the middle and upper parts -they are white sugar-like dense occurring in beds with the thickness being from I.00 up to 2.50 m. ..40.50 m.

9. On a washed out surface of gypsums,mainly in pockets, occur clays being lumpy of light-brick colour with greenish spots. Their thickness ranges from 0 up to I0.0 m. .....

Total thickness by the section is ..... 242.00 m.

Above with a washout occur redcoloured deposits of Neokome-Aptian stages. From the adduced section the paleontalogical remains have been selected among which by V.I.Kuznetsov the following are determined: from the lower part of the stratum: Plesiocyprina sp.,Aviculoperna (Isognomon) cf. caucasica Pcel.,Pinna sp.,Parallelodon cf. schoukovski Roll.,Protocardia cf.cancinnum Buch.,Modiolus sp.,Pseudotropezium sp., Terebratula sp.,Homomya aff. choffati Borissiak, Nerinea ex gr.germmulata Pcel.;

from the middle part: Neinea sp.,Pseudotrapezium sp., Aviculoperna (Isognomon) sp. ind.,Cardium sp.,Isocardium(?).

According to the conclusion of V.I.Kuznetsov this fauna has an interval of distribution of Oxford-Kimmerij and is widely known in Tajikistan.

At the same time from the collections of O.V.Cherkasov,V.I.Bratash and A.K.Dertev being prepared during different time from the lower part of the same section there are different forms adduced on the grounds of which O.V.Cherkasov considers the age of the enclosing rocks as to be conditionally Titonian. Without going into analyses of the before received material,as this question is specifically paleontalogical one, we had conditionally considered the age of the whole stratum,occurring above the Oxfordian limestones as to be Kimmerij-Titonian(?).

There are some data received by us which indicate to the fact that the describing deposits in the region of the Karkar-Dudkash occur on the Oxfordian ones with a break and with a non-evident unconformity. To this fact indicate two factors: I) small pockets and inwashes by

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by jointing into the Oxfordian limestones of the lying on them red-brown argillaceous clays,composing a basal bed of the above lying party-coloured stratum,and 2) in the above mentioned basal argillaceous clays small rare poorly rounded pebbles of limestone which is alike in outward appearence the belowlying Oxfordian one are observed here.

If the discontinuty between the Oxfordian limestones and the above-lying partycoloured-gypsumbearing stratum in the region of the Dudkash and Karkar is indeed present,and the stratigraphical scheme,proposed by V.I.Bratash is right,then apparently the whole described by us stratum should be related to the Guliobian series to the upper"partycoloured gypsum-bearing" subseries,the age of which V.I.Bratash considers to be Kimmerij-Titonian one.

To the North-West in the region of the Nakhrin village on a limited area the deposits of the Kimmerij-Titonian age(?) are again appearing. Their section here is not complete in consequence of numerous dislocations with a break in continuty.

Near the village of Nakhrin(fig.29,dr.44) it is evident as on the limestones containing Oxfordian fauna occur interstratification of clays being reddish-brown (thickness of beds 0.50-I.50 m.),of sandstones of greenish-grey colour being bedded fine-grained up to coarse-grained(thickness of beds 0.20-2.00 m.) and of aleurolites(thickness of beds 5.0-I0.0 m.). By the whole section lump and lenses of gypsum with the thickness up to 0.20-0.30 m. can be seen.

Total apparent thickness of these deposits is 60.00 m.

To the North from the village of Nakhrin in the section of these deposits gypsums reach the thickness of 20 meters.

In the Chal-Namakabian coal-bearing region the Kimmerij-Titonian(?) deposits have a sporadical distribution and are being exposed in tectonic blocks,often having a form of thrust sheets,mainly along the zone of the Chal-Namakabian regional overthrust.

The Kimmerij-Titonian(?) deposits are mainly represented by stratum of gypsums with subordinated to them red and green aleurolites and clays with the total thickness orientally being not less than 200 m.

Compound tectonic conditions of occurrence (for all this complicated by structures of chemogenic rocks currents) all this makes it impossible to constmuct a leaf-by-leaf section. From a number of places in these deposits paleontalogical remains have been selected,which are according to the conclusion of V.I.Kuznetsov characteristic for Sekwan. In the region of Karkar and Dudkash the analogical fauna had been met in the deposits,which we relate to Kimmerij-Titonian(?) stages.

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Until recently the question on the age of the rock salt, exposed in the regions to the North from the village of Chal and near the village of Takcha-Khana was a debatable one. The stratigraphical situation of the salt-bearing deposits described by S.V.Tromp(I954) under a name of the series of Namakab in a view of a very complicated mode of occurrence had been very debatable and unclear.

For the first time the salt-bearing deposits had been described by R.Furon(I926), who had related them firstly to Neogene and then(I94I) - to the lower Cretaceous age as an evaporitic facies of "redcoloured coarse sandstones" ("the Red Grit").

O.Gerbord (I926) and K.Brukl(I935) had related these deposits to the Tertiary system.

ZH. Bart(I933) had considered them to be probably Triassic and at least as Pre Cenomanian ones.

In the region of the Khanurkharan village, to the West from the coaly deposit of the Roshag we had observed a continuous section of Oxford-Callovian stages at the upper part of which among aleurolitic-gypsum-bearing part of the section with the thickness nearly 28 m. the Nurinea ex.gr. gemmulata Pcel. was met. Above these deposits without a noticeable discontinuty occur gypsums of the Namakabian salty-stone deposit. These gypsums are very strongly dislocated, but at some places the concordant felationship of them with underlying aleuritic-gypsumbearing deposits with Nurinea gemmulata is clearly pronounced. These gypsums apparently have Kimmerij-Titonian(?) age and are correlated with the gypsum of the same age of the Karkar-Dudkash.

The whole section of Callovian-Oxfordian deposits as well as of the above occurring gypsums remains here in an overturned position being at the marginal part of the allochthone of the Chal-Namakabian fracture, which has here a character of a gentle overthrust and being one of the constituent parts of the Ishkamyshian marginal juncture. The rock salt in the form of diapir core pearces these gypsums and is without doubt genetically related to them, as in the autochthone of the overthrust in the region of the Namakabian deposit the Pliocene deposits of the Rustak series are everywhere met, being mainly represented by coarse-terrigeneous rocks (conglomerates, sandstones, sandy clays) without any indications of gypsums or of rock salt neither in the region of the Namakab no in the adjacent regions.

At the same time, in Tajikistan, for example in the South-western Darwaza N.P.Ermakov (I938) and N.G.Wlasow (I962) mark in the upper Jurassic gypsumbearing series being of conditionally Titonian age the beds of rock salt. Rock salt and potash salt are widely known in the Gaurdakian

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deposits of the South-western offshoots of the Gissarian ridge, which until recently were related to the upper parts of upper Jurassic sections.*)

The stated above considerations led us to the conslusion that the rock salt of the Namakabian and Chal deposits has upper Jurassic and most probably Titonian age. Its outcrops are extreamly limited, possibly not only due to the primary non-general distribution of it, but due to the manifestation of erosional processes during lower Cretaceous time, which destroed a considerable part of upper Jurassic deposits on considerable areas of the investigated territory, as well.

The Bashekian series

In the Darra-i-Sufian coal-bearing region during the exploration of the coaly deposit of the Shabashek (1963) the series involving the very upper parts of the Jurassic section and which is occurring on the middle Jurassic deposits with a quite clear washout, had been singled out. This series which has at different places a somewhat various lithological character and which is being traced on a great area from the Sary-Assya in the East up to the Lela in the West, was given the name of the Bashekian series.

The structure of the Bashekian series can be characterized by a fragment of the section, constructed for the region of the Shabashek coaly deposit (fig.27, dr.32) beginning from the basement of the series up to the coaly bed No.24:

I. Sandstone light, yellow-brown in colour, being quartz-feldspatic, coarse-grained, at some places grading into gravellites and contains small pebbles. Towards the upper part of the section it is granding into fine-grained sandstone; unclear cross bedding is noticeble here .... 31.20 m.

2. Thin interstratification of aleurolites being greenish-grey with rare ferriferous concretions, of consolidated clays being grey with thin concretional interbeds of siderite and with vegetable detritus, of sandstones being yellowish-grey fine-grained. The beds have the thickness from 0.20 up to 2.40 m. Among the consolidated clays there are interbeds of coaly clays with the thickness up to 0.30 m., containing small lenses of lustrous coal with the thickness up to 0.08 m. are often met. The bed of hard coal of complicated structure with the thickness 2.80 m. (the benches of hard coal have the thickness 2.05, 0.53, 0.19 m. - the beds No.No.16 and 17) is met here too.....24.00 m.

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*) At present by V.P.Bratash (1965) the consideration on the lower Cretaceous age of the Gaurdak series(Berrias-Valanzhinian) is expressed

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3. Aleurolite thin-bedded with rare interbeds of consolidated clay with concretional interbeds of siderite with the thickness 0.20-0.07 m. and with interbeds of ochreous fine-grained sandstones, sometimes being horizontally bedded with vegetative detritus. In the upper part there is a coaly bed of complicated structure with the thickness being 2.69 m. .....I2.30 m.

4. Aleurolite greenish-grey unclearly bedded, sometimes lumpy with rare concretional interbeds of siderite with the thickness 0.02-0.05 m. with interbeds of fine-grained sandstone (separate interbeds have the thickness up to 4.00 m.) being horizontally bedded with vegetative detritus. At the upper part of the section there is a thin interstratification of aleurolites and consolidated coaly clays with thin interbeds of clayey hard coal with the thickness up tp 0.30 m. The bench is finished by the beds of hard coal with the thickness I.42 m.(the benches of the bed have thickness 0.68, 0.57, 0.I7 m.) ..... 30.00 m.

5. Interstratification of consolidated grey clays, sometimes black coaly with lenses of lustrous hard coal with the thickness up to 0.06 m. of aleurolites greenish-grey platy micaceous with small vegetative detritus. Thin concretional interbeds of siderite with the thickness 0.02-0.04 m., rare ferriferous concretions are observed. At the upper part of the section there is a coaly bed of compound structure with the thickness I.50 m. ("puff-pustry" - with the predominance of consolidated clays) ..... I8.00 m.

6. Clays consolidated dark-grey with great amount of coaly material At the middle part of the section there is an interstratification of lenses of clayey coal and of consolidated clay ..... 7.00 m.

7. Thin interstratification of grey, greenish-grey aleurolites with concretions of siderite and of consolidated grey clays. Beds with the thickness from 0.I0 up to I.80 rarely up to 2.70 m.; rare beds of fine-grained sandstone being unclearly bedded with vegetative detritus, with the thickness up to 0.70 m. Concretional interbeds of siderite with the thickness up to 0.25 m. are marked; at the upper part of the section there is a bed of compound structure represented by coal with the thickness up to 3.32 m.(the bed No.23) .....I8.00 m.

8. Interstratification of greenish-grey fine-grained sandstones, of aleurolites and in less amount of grey consolidated clays with abundant vegetative detritus and thin concretional interbeds of siderite. At the upper part -there is a bed of hard coal (the bed No.24) of compound structure with the thickness 0.86 m. (the thickness of hard coal benches is 0.34 and 0.5I m.) .....I7.00 m.

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9. Interstratification of light-grey fine-grained quartz-feldspatic sandstones, green-grey aleurolites and grey consolidated clays, sometimes being coaly. The beds have the thickness from 0.20 up to 0.60 m.

.....I2.00 m.

The thickness of the adduced part of the section is ..I69.00 m.

The more high parts of the section are alike the described one, with the exception of the very upper parts (nearly I40 m.) where grey with brown tint, sometimes red-brown aleurolites being micaceous, lumpy, rarely platy, containing rare interbeds with the thickness from I up to 5 m. of grey, sometimes slightly coaly clays and of arkose light fine - medium-grained sandstones, are the predominant. In this part of the section coal showings are completely absent.

On aleurolites, which finish the section of the Bashekian series, at a number of places a thin redcoloured crust of weathering is developed, on which transgressively with small angular unconformity occur deposits of Cretaceous time.

Total thickness of the Bashekian series in the region of coaly deposit of the Shabashek amounts 490.0 m.

In the section of the Shabashekian coaly deposit the Shabashekian series contains up to I7 beds of hard coal with the thickness being from 0.I3 up to 3.32 m.

The ratio of the rocks composing the Bashekian series (in stratotype) is the following: sandstones -25%, aleurolites- 40%, consolidated clays - 30%, hard coal - 5%.

In the lower and middle parts of the series in the region of the Shabashekian coaly deposit the remains of fossil flora have been selected, among which T.A.Sikstel determined the following: Dictyophyllum sp., Podozamites sp., Taeniopteris reversa Ptyn., Ctenis sp., Cladophlebis denticulata (Brongn.). The enumerated flora, according to the conclusion of T.A.Sikstel does not contradict the upper Jurassic age of the enclosing it deposits.

In the region of coaly deposit of the Sary-Assya (fig.3I, dr.33) the Bashekian series with a clear washout occurs on the Shabashekian deposits and has the following structure (from the bottom):

I. Sandstones brownish-grey at some places rusty coarse-grained and gravelly polymictic cross bedded massive with interbeds and lenses of fine-pebbly conglomerate ..... I9.30 m.

2. Clays consolidated, sometimes coaly black with interbeds of platy aleurolite with vegetative detritus ..... 4.70 m.

3. Interstratification of sandstones of yellowish-green colour,

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inequigranular with gravel and thin interbeds of conglomerates .. II.I0m

4. Interstratification of consolidated clays,brownish-grey aleurolites,fine- and medium-grained sandstones(thin interbeds) and consolidated,sometimes coaly clays being dark-grey or black coloured,especialy at the lower part,they contain lenses of lustrous hard coal with the thickness from 0.05 up to 0.45 m. ..... I02.00 m.

5. Sandstone yellowish-brown fine - and medium-grained,dense with lenses of gravellite ..... 9.00 m.

6. Interstratification of consolidated clays being often coaly blask and grey-brown aleurolites;rare thin beds of sandstones are met. In the middle part -there is a bed of hard coal with the thickness 0.8I m. ..... 23.00 m.

7. Sandstone fine-and medium-grained,analogical to that of the bed "5" with vegetative detritus ..... I3.00 m.

8. Consolidated clays grey with interbeds of aleurolite of grey-brown colour with vegetative detritus ..... I9.80 m.

9. Sandstones yellowish-grey medium-and fine-grained quartz-feldspatic with rare lenses of grey micaceous aleurolite ..... 23.60 m.

I0. Interstratification of aleurolites brown-grey,consolidated greenish-grey clays and rare interbeds of fine-grained sandstone..I5.00 m.

II. Interstratification of yellow-brown inequigranular sandstones, gravellites and fine-and medium-grained conglomerates,composed by medium rounded pebbles of quartz,black silicon,dense sandstones,metamorphic rocks,etc. ..... 34.00 m.

I2. Interstratification of aleurolites and consolidated clays..7.60 m

I3. Conglomerate light-grey being of uneven spoty colour,fine- and medium-pebbly with an admixture of coarse pebble with interbeds of sandstone;pebbles are composed of quartz,black silicon,metamorphic rocks. Cement is sandy clayey-silicious ..... 52.00 m.

Total thickness of the Bashekian series in the region of coaly deposit of the Sary-Assya is ..... 325.00 m.

Above with a washout occur deposits of Cretaceous age.

The ratio of the rocks in the section is as follows: conglomerates 22%, Sandstones-33,4%, aleurolites-23%,consolidated clays-23%,hard coal- 0.6%.

In the section of the Shabashekian series of the Sary-Assya region under the decreasing of the total thickness of the deposits,the appearence of conglomerates,encreasing of sandy material quantity,sharp decreasing of aleuritic and clayey material is observed;coal-forming has a

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small scale.

To the West from Shabashek the deposits of the Bashekian series have been established in the region of the coaly deposit of Dakhani-Tor.

Here at the left slope of the Dakhani-Tor valley with a noticeble washout on "the upper part" of the Shabashekian series (fig.35,dr.3I) the series of the following structure is lying (from the bottom):

I. C onglomerate grey medium-pebbly with an admixture of gravell with siliceous-clayey-carbonaceous dense cement. Not very clearly pronounced cross bedding is noticeble. Pebbles are medium rounded and are composed of white quartz,quartzite-like sandstones,limestones,siliceous schists,etc. ..... I3.30 m.

2. Clays grey-green with interbeds (lenses) of brown aleurolites, being micaceous unclearly bedded ..... I8.I0 m.

3. Interbedding of clays being lumpy green and brown-fallow,the interbeds have the thickness of 0.30-0.40 m. ..... 3.90 m.

4. Clays green-grey,bluish dense at some places aleuritic with rare interbeds of brown sandstones with the thickness up to 0.50 m...I6.20 m.

5. Clay grey fat lumpy with vegetative carbonificated detritus;at the middle part it is dark coaly ..... 7.00 m.

6. In the lower part (8-20.0m) - there are sandstones of light-grey colour with rusty-brown spots and lenses of gravell and fine-pebbly conglomerate,the quantity of which is various,they often predominant over sandstones. In the upper part of the section - there are sandstones which grade into red-brown conglomerates being gravelly-pebbly strongly ferruginized with ferriferous (limonite) crust at the upper parts. Conglomerates are composed of medium-rounded pebbles with the size I-3 cm. of white quartz,black hornfel and metamorphic rocks. Cement is siliceous-clayey,dense slightly ferruginized..... 29.20 m.

7. Interstratification of sandstones,being grey,loose,fine-grained of aleurolites being greenish-grey and of aleuritic clays of greenish-grey colour. Violet-grey tints are more often marked at the upper parts of the section ..... I6.90 m.

8. Sandstones light yellowish fine and medium-grained with diagonal bedding;in the lower parts of the section - with lenses of gravel-pebbly material with the thickness up to I.50 m. Pebbles are medium-rounded with the size up to 2 cm. of the same composition as before.. I5.20 m.

9. Sandstones bluish-grey up to yellow-green fine-grained loose .. .. 23.70 m.

I0. Interstratification of red-brown aleurolites,being sandy and lumpy clays and of bluish-grey fine-grained sandstones ..... I7.30 m.

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II. Below - (nearly I.0 m.) conglomerates of red-brown colour, fine-pebbly with red-brown sandy-clayey cement; above - sandstones of light-grey colour with diagonal bedding, slightly calcareous, sometimes with lenses of gravellite and of red-brown aleuritic clay ..... II.70 m.

I2. Sandstones light bluish-grey fine-grained of schistose structure micaceous slightly calcareous, containing rare interbeds of red-brown and grey-blue aleuritic clay, being of spoty colour ..... 42.80 m.

I3. Clay red-brown sandy calcareous in the middle part with lenses being composed of almost non-rounded at all fragments of white quartz, black hornfel, metamorphic rocks with the size of from I up to 5 cm. ..
..... 2.90 m.

I4. Sandstones yellowish, yellowish-grey, grey micaceous with lenses of gravellite and fine-pebbly conglomerates ..... 6.70 m.

I5. Sandstones of bluish-grey colour with red spots and strips with calcareous concretions, in the middle part of the bed there is an interbed of grey dense limestone with an admixture of gravelly and fine-pebbly material ..... 5.30 m.

I6. Aleurolites of greenish, yellow-brown colour, in the lower part of the bed they are partycoloured (red-blue) thin-bedded with calcareous concretions; cement is dense calcareous-dolomitic ..... 4.80 m.

I7. Sandstone of brown colour fine-grained calcareous with gravelly and fine-pebbly material; it contains fine vegetative detritus and unclear imprints of plants; below limonitization and ferriferous (limonitic) crusts are marked ..... 40.00 m/

Sandstones of the bed " I7" with a clearly pronounced washout are overlapped by limestones of Senoman-Turonian age.

Total thickness of the Bashekian series in the region of the Dakani-Tor amounts 274.00 m.

The ratio of the rocks in the section is as follows: conglomerates--I4%, sandstones - 60%, aleurolites -9%, clays -I7%.

The distinctive faature of the Bashekian series section in the region of the Dakhani-Tor is complete absence of not only beds of hard coal, but phenomena of coal-bearing as well. In the upper parts of the section as well as in the region of the Shabashek, here the rocks of brown and of red-brown colour, being apparently characteristic for the upper parts of the Bashekian series in another regions too, are marked.

The deposits of Bashekian series have been established to the South-West from the village of Lela too. They have been represented by alternation of benches of sandstones, consolidated clays and subordinate ale-

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urolites with fine vegetative detritus. The absence of coal-bearing features is a characteristic phenomenon here.

At the left slope of the Lela river, concordantly on the deposits of "the upper part" of the Shabashekian series (fig.36, dr, 34) the following rocks occur:

I. Sandstones of grey, dark-grey colour, stripped, spoty medium-and fine-grained polymictic with thin interbeds of aleurolites and consolidated clays of grey-yellow colour with the thickness up to 0.30 m. ... . I5.60 m.

2. Consolidated clays of grey, light-grey, yellowish colour, slightly calcareous thin-bedded sometimes sandy ..... 52.00 m.

3. Sandstones of light-grey colour, medium-grained thin-platy, slightly calcareous ..... 9.30 m.

4. Clays consolidated sandy with thin interbeds of aleurolites (the thickness being up to 0.50 m.) being greenish-grey in colour and rarely with beds of fine-and medium-grained sandstones with the thickness from 0.50 up to 5.0 m.; clays contain interbeds with fine vegetative detritus. In the upper parts of the bed sandstones have yellow-grey, brown-grey and rarely reddish-grey colour. In separate interbeds clays have violet-red colour, sometimes bright-green one..... . 2I2.30 m.

5. Sandstones light, yellowish-grey, brown with lenses of gravellite and conglomerate composed of fine and middle pebbles of white quartz, black silicon, metamorphic rocks; rare ferruginized concretions are also present here ..... 32.00 m.

The deposits of the Bashekian series near the village of Lela have total thickness of ..... 320.00 m.

Here as well as at another places the horizons of the section have brown and red-brown colour.

In all the described sections the deposits of the Bashekian series with a washout and sometimes with slight angular unconformity (not more than 5°) are overlapped by upper Cretaceous deposits.

The maximal thickness of the Bashekian series is established in the region of the Shabashek and amounts 320-325.0 m., the minimal one is observed at the Dakhana-Tor being 274.0 m.

In the region of the Ishpushta the upper Jurassic, supposedly Callovian deposits have the thickness of 4I3.0 m.

The sedimentation of sediments of the Bashekian series, for the exception of the very its upper parts, took place in the same conditions as those of the Shabashekian series of the middle Jurassic age.

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The presence in some horizons,for example in the region of coaly deposit of Shabashek,of numerous interbeds of siderite with a concretional structure " cone in cone " as well as of rounded form concretions of siderite and limonite,the absence of coarse pebbly material,all this speak in the favour of still swampy or swampy-alluvial conditions of the sediments accumulation in the conditions of humid climate.

The appearence of brown and red-brown colour of the rocks and dissappearence of coals by the whole section or in the upper part of the series,as it takes place at the Shabashek,apparently testifyes to a sharp increasing of aridness of climate. The latter fact had apparently been characteristic for the end of Jurassic age(Kimmerij-Titon) for a vast territory,involving not only the northern Afghanistan,but the mixed regions of the Tajikian depression as well. Taking into consideration all these suggestions one can presume the age of the Bashekian series within the limits of Callovian-Titonian stages. To an analogical conclusion had come G.N.Khatiskatsi and A.K.Dertev and others (I963) concerning the upper parts of the Jurassic section in the region of coaly deposit of the Dakhani-Tor. However,this assumption is still being unproved.

Upper Jurassic Deposits(undissected)

In the Darra-i-Sufian coal-bearing region undissected upper Jurassic deposits are mainly singled out in its eastern marginal part. The section of upper Jurassic deposits in these regions is somewhat different from the before described sediments of the Bashekian series,developed to the West. For example,in the section of the Aokhorak (I0 -I2 km. to the South-East from the Sary-Assya,fig.33,dr.36) the thickness of the upper Jurassic deposits is decreased up to I63.0 m.,for all this,the role of conglomerates in the section is increased up to 30%,coal-bearing is practically absent. The adduced data apparently testify to the proximity of the borts of the depression and of the sources of removal of terrigeneous material,located to the South-East from the Aokhorak. This assumption is well correlated with our idea on the localization of depressions on the investigated territory,which had accumulated the sediments and of areas of denudation and of washout (fig.9).

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C R E T A C E O U S S Y S T E M

Within the limits of the investigated territory the Cretaceous system has been represented by the two divisions. The Cretaceous deposits (including the united Dat-Paleocenic) are everywhere developed, for the exclusion of the North-eastern part of the territory. They compose vast areas and involve the area of nearly 4600 sq.km., that is 33% of the territory. They usually occur at low angles, forming flat dome-like folds and have steep angles of diping near fractures only. The red-coloured stratum of Neokom-Aptian age (the series of "Red Grit" of K.L.Grissbakh and G.G.Gaiden) of which the section is beginning, with a slight unconformity overlains the more old formations. Above by the section the Cretaceous deposits are concordantly replaced by Paleogene ones.

Among the Cretaceous deposits the undissected Neokomian and Aptian Albian, and united and undissected Senomanian and Turonian, Konjakian, Santonian and Kompanian stages undissected, Maastikhtian stage, united Datian stage and Paleocene* (fig.43) have been singled out by us.

The L o w e r d i v i s i o n

Among the lower Cretaceous deposits, being very limited in their distribution, the undissected Neokomian and Aptian stages and Albian stage have been singled out.

N e o c o m i a n a n d A p t i a n stages(undissected)

Red-coloured terrigene-sedimentary deposits of Neokomian and Aptian stages form sporadical outcrops in erosional windows predominantly in central and western parts of the investigated territory. They have been composed by conglomerates, gravellites, sandstones, aleurolites and clays, limestones are als o met.

Conglomerates are of pinkish-grey, grey, brown, red-brown, red colour, being represented by inequipebbly, fine-, middle- and rarely coarse-pebbly varieties. Pebbles are well rounded medium or poor sorted. In pebbles the following minerals are met: quartz, quartzites, mica-quartzy schists, aleurolites, sandstones, argillites, limestones, horngels, effusive rocks, granites, etc. in dependence of the composition of the underlying deposits. Cement is sandy-aleurite-clayey, sometimes slightly calcareous, basal or of interstitial type. Conglomerates are interstratificating with sandstones, forming benches up to 30-70 m. in thickness.

Gravellites are grey, brownish-red mainly composed by grains of quartz. They often contain fine dissiminated pebble of various rocks. Cement is sandy-aleuritic-clayey, basal or interstitial one.

Sandstones and aleurolites have red, pinkish-grey, brown-red, rarely - grey or spoty grey-red or greenish-grey colour. Among sandstones there are fine-, medium-, coarse and inequigranular varieties singled out, sometimes pudding; among aleurolites - fine-, medium-, and coarse-grained.

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In composition the rocks are oligomikt,materially quartzy,or polymictic,composed of semi-rounded or rounded (rarely angular) grains of quartz, peliitizated,sericitizated and chloritizated feldspars,quartzite,effusive rocks,flakes of muscovite,biotite,chlorite; singular grains of epidote are met. Cement is different: cloty,basal,corrosional,in the structure is irregular-granular,rarely crusty,in composition is calcitic,ferriferous,sericite-calcite-ferriferous.

The rocks are coarse-bedded,sometimes cross-bedded;aleurolites are usually clayey.

Clays are red-brown or spoty,greenish-blue,usually containing an admixture of sandy-aleuritic material,being micaceous,lumpy.

Limestones are of grey colour and extreamly rarely met in thin(up to I m.) lenses. They are strongly sandy,containing small dissiminated pebbles too.

The section,observed at the left bank of the Surkhab river in the region of the coaly deposit of the Ishpushta(fig.8,dr.6I) gives the idea on the structure of the describing red-coloured stratum. With a washout and small azimuthal ($I0^{o}$) and angular ($I0-I5^{o}$) unconformities on the upper Jurassic deposits the following rocks are occurring:

I. Conglomerates brown-red coloured,medium-and coarse-pebbly with interbeds of sandstones ..... 40.7 m.

2. Conglomerates pinkish-red medium-pebbly with interbeds of sandstones. ..... I5.0 m.

3. Sandstones spoty red-grey clayey,with lenses of conglomerates.. ..... 25.0 m.

4. Sandstones grey calcareous with interbeds of conglomerates and calcareous limestones(at the roof) ..... 27.0 m.

5. Interbedding of red-brown,pink,grey conglomerates,sandstones, rarely of clays being sandy ..... 300 m.

6. Sandstones of red colour (in some interbeds -bluish-grey) with rare interbeds of conglomerates and sandy clayes..... I08.0 m.

7. Conglomerates brown with interbeds of sandstones,being of red-brown colour ..... 74.4 m.

8. Sandstones of red-brown colour,fine-grained,in some interbeds being pudding or clayey ..... 74.5 m.

9. Conglomerates rubbly-pebbly with lenses of sandstones. 28.2 m.

I0. Sandstones red-brown pudding,sometimes clayey with interbeds of conglomerates ..... 223.0 m.

II. Conglomerates medium-coarse pebbly ..... 22.0 m.

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* from the page 208 In view of lithological monotony and of the absence of clear boundaries of change of complexes of fossils,being for all this very poor-the Datian and Bukharian stages are singled out by us jointly.

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I2. Sandstones red-brown spoty with rare interbeds of conglomerates..... 55.0 m.

I3. Conglomerates pebbly-rubbly with lenses of sandstones.. 32.8 m.

Above with a washout and unconformity occur Maastikhtian deposits (fig.44). Total thickness of the Neokom-Aptian deposits of the adduced section amounts I026.9 meters.

Alike in the structure section of the Neokome-Aptian deposits can be observed directly to the East from the coaly deposit of the Dudkash. On a washed out surface of the gypsum-bearing stratum of the Kimmerij-Titonian stages,protruding into it by separate "pockets" the following rocks are occurring:

I. Clays light-bricky,sometimes spoty,greenish-red .....0-I0.0 m.

2. Sandstones brown-red coarse-grained,often being puddingous with lenses of gravellites and conglomerates which are fine-pebbly .. 84.3 m.

3. Sandstones grey-blue fine-grained with interbeds of lumpy aleurolites,in the roof there are clays of red-brown colour,schistose,sandy, with gravell and pebbles ..... 38.9 m.

4. Sandstones red-brown,in some interbeds grey-blue,puddingneous.. ..... I7.3 m.

5. Conglomerates red-brown inequipebbly,interbeds of clayey sandstone..... 48.I m.

6. Sandstones red-brown and schistose clays..... 6.0 m.

7. Sandstones bluish-grey fine-grained,calcareous,in some strips being red-brown,to the roof - puddingneous ..... 30.0 m.

8. Conglomerates pinkish-grey fine-pebbly with lenses of sandstone ..... 20.0 m.

9. Sandstones red-brown fine-grained quartzy ..... 9.5 m.

I0. Sandstones greenish-grey(in some interbeds being red-brown), fine-,and medium-grained,cross-bedded ..... 55.0 m.

By the wavy boundary of a washout on them the following rocks are occurring:

II. C onglomerates grey being fine-,medium-pebbly .....I4.0 m.

I2. Sandstones greenish-grey medium,-and coarse-grained,puddingneous with interbeds of red-brown aleurolites and conglomerates..24.I m.

I3.Sandstones red-brown fine-grained micaceous lumpy ...I7.5 m.

I4. Aleurolites red-brown ..... 27.0 m.

With a non-considerable washout above lie Albian deposits.

Total thickness of the deposits of the adduced section reaches 40I.7 meters.

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Near the Western boundary of the investigated territory, by the left bank of the Chakhar-Dekh (Darra-i-Suf) river with a washout on the upper Jurassic deposits the following rocks are occurring:

I. Gravellites of grey colour quartzy with lenses of sandstones... ..... about 50.0 m.

2. Aleurolites cherry-lilac below, and red-cherry above, with interbeds of sandstones and clays ..... about 40.0 m.

3. Aleurolites brownish-grey, reddish-brown, sometimes banded... ..... about I5.00 m.

4. Gravellites and sandstones brownish-grey, reddish-brown with interbeds of aleurolites..... about 60.0 m.

5. Aleurolites yellowish-brown, cherry-red, fine-grained, micaceous ..... 2.00 m.

With a washout on them lie Senoman-Turonian deposits.

Total thickness of the Neokome-Aptian deposits of the adduced section amounts about I67 m.

At the distance of 6 km. to the South-West from the described section, up-stream the river by the same bank, the thickness of analogical deposits (also occurring on the upper Jurassic and overlapped by the Senoman-Turonian deposits) is increased up to 304 m:

I. Interstratification of white and pink sandstones (interbeds up to 3-I0 m.) with red aleurolites and clays ..... 45.6 m.

2. Sandstones pink and red puddingmeous, rare interbeds of aleurolites ..... 63.9 m.

3. Interstratification of conglomerates being red-brown and of sandstones ..... 97.0 m.

4. Sandstones brownish-red puddingneous, towards the roof being fine-grained, with interbeds of conglomerates ..... 97.5 m.

By the left bank area of the Saihan river at the basement of the redcoloured series the bench (being in the thickness 40-60 m.) is singled out, composed of light-grey conglomerates, sandstones and aleurolites, with rare interbeds of pale-red sandstones and aleurolites. This basal bench with a slightly pronounced washout and with non-considerable angualr and azimuthal unconformities (up to I0-5°) occurs on the upper Jurassic terrigeneous formations. Sometimes the cutting out by it of separate horizons and even of the whole series of the upper Jurassic can be observed. However, more often angular unconformities are very small or absent at all, and one can speak about stratigraphical unconformity only, which is dividing the redcoloured series of the Neokom-Aptian and of the partycoloured series of the upper Jurassic ages.

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The Neokom-Aptian deposits here are overlained by Maastikhtinam ones, reaching at the extent of 20 km. from the mouth of the Saihan river to the West the thickness of I20 m.,I70 m.,I40 m.

The Neokom-Aptian deposits are everywhere composed of the same fragmental rocks. Their separate sections in greater degree differe in the thickness. It reaches 200-300 m. at the distance of 5 km. to the North from coaly deposit of the Dakhani-Tor (by the right bank of the Darra--i-Suf river),and above 400 m. - in the sai of Surkhshar (II km. to the West of the Madr village),about 600 m. to the North-West from the village of Madr (the right bank area of the Aokhorak river). At the distance of some km. up-stream the river the thickness exceeds 300-400 m. and is decreased to the North from the village of Madr (the right bank of the Aokhorak river,6 km. to the South-West from the village of Doab(Tatar) up to I5-20 m. The thickness of the Neokom-Aptian deposits being above I48 m. to the East from the Kalagai village (at the upstreams of the Larkhob sai),decreasing to the North (the up-streams of the Sia-Darra river) up to 40 m. The maximal thickness -being above I000 m. the redcoloured deposits of Neokom-Aptian stages reach in the region of coaly deposit of the Ishpushta, without exceeding at another places 200-400 m. and often amounting even less than I00 m. Such ranges are apparemtly connected with both the washout during the Albian-Turonian Maastikhtian transgression,and primary irregularity of accumualtion of the Neokom-Aptian deposits in the conditions of aqueous environment in separate depressions of compoundly dissected Pre Cretaceous relief.

In the described deposits we did not discover any fossils. Their age is conditionally considered to be Neokom-Aptian on the grounds of the situation in the section. In the region of coaly deposits of the Dudkash Karkar they with a washout occur on Titonian and with non-considerable washout are overlained by Albian deposits. Analogical situation (above Titonian and under Albian deposits) m have the redcoloured terrigeneous deposits in more northern regions of Afghanistan. In the upper part of the section we have found the fossils,which are characteristic for the Aptian (Amphidonta subsinuata Lam.,Ostrea solyphera Coq.) and Barremian (Ostrea cos.Coq.,O.cornueli Coq.,O. cf.leymerri Desh.,Opis cf.neocomensis Orb.) stages. (V.I.Bratash and others,I96I,Khatiskatsi G.N., and others,I963). However, taking into consideration the fact that the Cretaceous transgression had come from the North,it is not excluded that in separate sections to the South and West from the described one in Dudkash,the interval of accumulation of redcoloured deposits could have been wide one. It could have involved the very end of the upper Jurassic epoch(for example a part of Titonian age) and continued possib-

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ly up to the end ofthe Albian age or the beginning of the upper Cretaceous epoch,However,it can be cleared out after the corresponding study of lithologo-facial changes of Cretaceous deposits from the North to the South on a considerable area.

A l b i a n s t a g e

The deposits of Albian stage are distributed on a smallest area,as comare with the other subdivisions of the Cretaceous system. They have been established by the two banks of the Puli-Khumri (Surkhab) river - near the town of Puli-Khumri and coaly deposits of the Dudkash and Karkai as well as to the East from the village of Nakhrin only. The Albian deposits have been composed of limestones,marls,clays,sandstones;gypsums are also met.

Limestones have yellowish,-brownish-grey,brown-fallow,brown colour. Organogeneous-fragmental sandy varieties and sandy limestones,being sometimes glauconitic,fine-crystalline or aphanitic are the predominant. Organogeneous-fragmental material is represented by fragments of echinoderms,bryozoans,shells of gastropoda,pelecipoda,and the sandy one - is practically exclusively by rounded and semi-rounded grains of quartz, quartzite and alterated feldspars,which compose up to IO-20% of the rock. The describing rocks are unclearly-bedded or bedded,with thin-and medium-platy jointing. Greenish-grey aphanitic limestones,in a considerable degree being dolomitizated(crystalls of dolomite form nests,and compose up to 20-50% of the rock),sometimes brecciated,lumpy.Limestones are interstratificating with sandstones and clays,composing benches with the thickness up to 33 m.

Marls are of light-grey,greenish-grey colour,being aleuritic or sandy,thin-bedded or platy and compose singular interbeds among clays.

Clays are schistose,argillite-like,being coloured in green,bluish-green,red-brown colour,or they have spoty dark-red-green colour. They have fine-lumpy,foliated or thin-lammelar texture.

Sandstones are of grey,yellowish-grey colour represent by themselves banded rocks,also platy,sometimes dense and hard. Among them fine-and medium-grained varieties,being strongly calcareous are singled out. In composition they are oligomictic,and are mainly composed by semi-rounded and rounded grains of quartz,in less degree-of quartzite and alterated feldspars.

Gypsum is of white colour,also of light-pink,yellowish-pink colour, massive (in weathered condition it is loose) and forms thin -up to 0.2 m interbeds among clays.

The structure of the Albian deposits is characterized by the following section(fig.45,dr.53) observed by the left slope of the Chinor-Darra sai (the left tributary of the Tangi-Nakhrin river,3 km. to the South-East from the village of Nakhrin). By a clear,sharp,slightly wavy boundary of a washout with an angular and azimuthal unconformities (up to IO-25°) the redcoloured series of Neokom-Aptian deposits are overlained by the following:

I. Sandstones grey fine-grained calcareous ..... I.5 m.

2. Limestones brownish-grey organogeneous-fragmental,medium-coarse-

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crystalline with Praeradiolites sp. .....I.5 m.

3. Interstratification of brownish-grey limestones being organogeneous-fragmental(interbeds up to I-2 m.) with Exogyra localis Mordv.var., Gryphea sp.,Cucullae sp. and of sandstones fine-grained,calcareous.... ..... 34.0 m.

4. Limestones brownish-fallow fine-and very fine-crystalline, sandy ..... 6.0 m.

5. Interstratification of green,red-brown and spoty clays; in the middle and upper parts of the bench there are several interbeds (up to I-2 m.) of light-green marls ..... 40.0 m.

6. Interstratification of green and red clays with five interbeds (up to 0.2 m.) at the basement of white and pink gypsum..... 20.0 m.

Above the Senoman-Turonian deposits are concordantly occurring.

Total thickness of the Albian deposits of the described section amounts I03 m.

In the region of coaly deposit of the Dudkash the section of Albian deposits has the following character(fig.45,dr.52);apparently with a non-considerable washout on the Neokome-Aptian deposits the following deposits are occurring:

I. Sandstones of yellowish-grey colour,being fine-grained,calcareous thin interstratificated (0.I-0.2 m.) at the basement and at the roof-with brown limestones being organogeneous-fragmental..... 39.3 m.

2. Limestones brown,yellowish-grey organogeneous-fragmental..30,5 m.

3. Sandstones yellowish-grey fine-grained ..... 5.0 m.

4. Limestones brownish-grey organogeneous-fragmental and micro-crystalline ..... 32.8 m.

5. Clays greenish-grey schistose lumpy..... 6.2 m.

6. Limestones brownish-grey microcrystalline..... I2.2 m.

7. Clays greenish-grey,brownish-fallow schistose,lumpy.... 8.6 m.

8. Limestones yellowish-grey microcrystalline with an interbed of gypsum(0.Im.) ..... 2.5 m.

9. Clays bluish-green schistose,fine-lumpy or thin-foliated with frequent interbeds (up to 0.I5 m.) of light-pink gypsum ..... 28.0 m.

The described deposits (reaching here the thickness of I65.I m.) are concordantly replaced by the Senoman-Turonian ones.

The alike to the adduced section is observed in the region of the Puli-Khumri town too (Makhnev and others,I962;fig.45,dr.5I). With a washout on the Neokome-Aptian deposits the following are lying:

I. Bench of sandstones. Sandstones are yellowish-grey,fine-and medium-grained with interbeds of limestones being organogeneous-fragmental-fragmental at the basement with Acanthoplites sp.,and of sandsones

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being puddingneous with semi-rounded pebbles ..... 50-60 m.

2. Bench of limestones. Limestones are grey organogeneous-fragmental, at some places being fine-oolithic with interbeds of sandstones..
..... 35-60 m.

3. Bench of clays. Clays are greenish-grey with interbeds of marls, limestones and gypsums. Microfauna of Anomallina ex gr. biinvoluta Mjatluk, Globigerina aff. infracretacea Glaessner, Anomalia sp., Miliolina sp. . ..... 25-48 m.

Total thickness of the Albian deposits in the adduced section reaches II0-I68 m. Above they are concordantly replaced by the Senoman-Turonian formations.

Thus, the thickness of the Albian deposits is slightly increased from I03 m. in the North-eastern part of the field of their distribution being extended in the form of narrow broken strip from the village of Nakhrin in the North-East up to the town of Puli-Khumri in the South-West - up to I68 m. in the South-West (fig.45)

The Albian age of the described deposits is confirmed by the found by us fossils.

As it was already mentioned, within the limits of the investigated area the describing deposits with a non-considerable washout occur on the Neokome-Aptian formations and being overlapped by Senoman-Turonaian ones.

The Albian deposits had been accumulated in a shallow and warm marine basin, corresponding to the beginning of the transgression of the Cretaceous sea from the North. The transgression had apparently been non-considerable one (the accumulation of fine-fragmental-carbonaceous deposits of near-shore facies of small thickness), which had stopped for some time, or even changed by partly regression (the appearence of interbeds of gypsum) at the end of Albian age. It is most probable, that the Albian sea had not at all come to the South from the line of the Nakhrin-Puli-Khumri.

Senomanian and Turonian stages

The Senoman-Turonian deposits are singled out almost everywhere, where the Cretaceous deposits are singled out in general. In the sections of the Puli-Khumri-Nakhrin region they in the form of an united stratum, without marks of break of continuty, contain Turonian fossils, and concordantly occur between the Konjiakian and Albian formations(fig.47). That is why one can suppose that in the mentioned region the two stages are present in a complete volume and single out them as Senoman-Turonian

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joint formations.

Another picture can be seen in the western regions, where Senoman-Turonian deposits begin the section of Cretaceous system, and with a wash-out and unconformity occurring on more old formations (fig, 48). Besides it the Senoman-Turonian deposits with a washout are overlapped in the same regions by Maastikhtian deposits. That is why one can affirm that the Senomanian and Turonian deposits are present in far non-complete volume; we single out, here the undissected Senoman-Turonian deposits. It is natural, that their thickness is in general less, than the thickness of the joint Senoman-Turonian deposits.

Both deposits are in general represented by the same complex of rocks. They are limestones, marls, clays, aleurolites, sandstones, and gravellites.

Limestones are light-greenish-rusty-brown and greenish-light-grey and known in various varieties. They are massive microcrystalline or aphanitic rocks, sometimes being thin-porous, coarse-banded (fig. 46). Usually they contain little admixture of aleurolitic and sandy grains of quartz, feldspars, flakes of muscovite. Sometimes the rocks are slightly dolomitizated. However, at the basement of the sections the light-brown limestones strongly dolomitizated (up to 20-50% of the rock is composed of rhombohedrons of calcite), sparkling in the sun are often met, Limestones are often being aleurolitic or sandy (fragmental material makes up up to 10-30% of the rock), sometimes contain gravelly material. Microoolithic sandy limestones are known also, being sometimes glauconitic. Organogeneous--fragmental limestones, mainly being coarse-detrital are often met. Up to 60% of their mass compose the fragments (1-4 mm.) of shells of pelecipoda gastropoda, brachiopoda, remains of echinodermatas, and bryozoans. They have been distributed in micro-or fine-grained calcitic mass, often being slightly dolomitizated, clayey, with small admixture of aleurolitic or sandy grains. The rocks are ususlly banded with platy jointing. Together with clays they are predominant in all the sections.

Marls have greenish-brownish-grey, brownish-green or lilac colour. As a rule they are aleuritic or sandy, micaceous, thin-banded, with fine- and irregular-platy jointing.

Clays are met of green, greenish-bluish-grey, cherry-red, red colour. they are schistose, sometimes thin-platy, micaceous, calcareous, sometimes being saturated with gypsum. Usually clays have fragmental-pelitic structure. In the ground carbonaceous-clayey mass (being sometimes ferriginized) microgranular seggregations of calcite, often aleurolitic and sandy grains of quartz, feldspars, quartzite, composing up to 15-30% of the rock.

Aleurolites, sandstones and gravellites of greenish-brownish-grey colour always being strongly calcareous. Aleurolits fine-grained, sometimes being puddingneous, micaceous. Gravellites are composed of grains of quartzites, clays, aleurolites, marls, limestones and contain disseminated pebbles with the size of up to 1-3 cm. of the same rocks. Spaces between gravelly grains are filled by sandy-aleuritic material, cemented by carbonaceous-clayey or clayey-carbonaceous-ferriferous mass.

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Senomanian and Turonian stages united

To the East from the village of Nakhrin (fig.47,dr.53) concordantly replacing the described above Albian deposits the following ones are lying:

I. Limestones brownish-grey microoolithic sandy .....I.5 m.

2. Interstratification of green and red clays,being schistose... ..... I9.0 m.

3. Marls greenish-grey sandy ..... I.0 m.

4. Clays green coloured schistose ..... 3.0 m.

5. Limestones brownish-green organogeneous-fragmental ..... 4.0 m.

6. Sandstones spoty green-pink,lilac-blue..... 5.0 m.

7. Interstratification of green and red schistose clays .... 7.0 m.

8. Limestones pink-red aphanitic with rare organic detritus I.0 m.

9. Limestones spoty green-pink,lumpy,sandy ..... 3.0 m.

I0. Limestones brown aphanitic with rare organic detritus... I.0 m.

II. Clays red schistose with nests and interbeds of green clays... ..... 20.0 m.

I2. Limestones light-brown,brownish grey,lumpy or breccialike with Caprinula soluni Bobk.,Gyropleura sp.,"Nautilus" sp.,Gryphaea vesiculosa turkestanica Bobk., Inaoceramus sp.,Hemiaster sp.,Modiolus sp (the grading bench between the upper Senomanian and lower Turonian stages) rare interbeds (up to 0.5 m.) of green clays .....I2.0 m.

I3. Clays green schistose thin-platy . ..... I5.0 m.

I4. Limestones brownish-fallow microcrystalline ..... 3.0 m.

I5. Interstratification of green clays being schistose,micaceous, aleuritic,calcareous with Amphidonta columba Lam.var.chaperi Bayle,and of greenish-grey sandstones being fine-grained .....I5.0 m.

I6. Limestones greenish-grey glauconitic sandy..... 3.0 m.

I7. Limestones greenish-grey,greyish-green glauconitic,sandy with Mammites nodosoides Schloth.var.chivensis Arkh.,"Nautilus" sp.,Inoceramus labiatus ..... 20.0 m.

I8. Limestones light-grey microcrystalline,sandy .....I7.0 m.

I9. Turfed slope with scattered rock fragments of lumps of limestones,brownish-grey thincrystalline and organogeneous-fragmental.... ..... 35.0 m.

20. Limestones brownish-grey -or fine-crystalline,apparent thickness is .... 2.0 m.

2I. Turfed slope with scattered blocks of the above described limestones..... ..... I4.0 m.

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22.Limestones light brownish-grey,aphanitic,apparent thickness is ....4.0 m.

23. Turfed slope with scattered fragments of blocks of limestones, being brownish-grey,fine-crystalline .....26.0 m.

24. Limestones brownish-green organogeneous-fragmental,fine-crystalline ..... 6.0 m.

Total thickness of the Senoman-Turonian deposits of the described section amounts 237.5 m. Above them the Konjakian deposits are concordantly occurring.

In the region of coaly deposit of the Dudkash (fig.47,dr.52) the section of Senoman-Turonian deposits,which are concordantly occurring of the Albian ones (see above) has the following character:

I. Limestones grey,greenish-grey,fine-crystalline,dolomitizated, at the basement being cavernous..... 4.5 m.

2. Sandstones greenish-grey,fine-grained,calcareous,glauconitic... ..... 46.6 m.

3. Clays greenish-grey,schistose,aleuritic,micaceous,in the upper part of the bench grading into aleurolites,being grey-coloured,calcareous,micaceous ..... 43.4 m.

4. Limestones brownish-grey fine-crystalline..... I2.5 m.

5. Limestones grey aphanitic with Inoceramus sp. .... 5.0 m.

Total thickness of the Senoman-Turonian deposits of the described section amounts II2 m. They are concordantly replaced by Senonian deposits.

In the vicinity of the Puki-Khumry town (fig.47,dr.5I) the section of Senoman and Turon is represented by the following deposits (Makhnev A.M. and others,I962),concordantly occurring on the Albian ones:

I. Clayey bench. Clays are dark-green,brown with interbeds of aleurites being grey,marls being greenish-grey,pinkish-yellow,limestones of grey colour with Ichtyosarcolites aff.Jokungensis Bobk.,I.cf.jolunensis Bobk.,Exogyra cf.olisiponensis Sharpe, Ex. aff. olisiponensis Sharpe, Amphidonta columba Lam. .....47-74.0 m.

2. Bench of limestones. The limestones are light-grey,organogeneous-fragmental with interbeds of gravellites..... 42.0 m.

3. Limestone-sandstoneous bench.The sandstones are yellowish-grey fine-,and meduim-grained,grading into limestones with Amphidonta columba Lam.var.chaperi Bayle,Inoceramus cf. herzynicus Petrasch.,I.labiatus Schloth.var.lata Sow.,Exogyra turkestanensis Bork.,Grypheae vesiculosa turkestanica Bobk. .....40-54,0 m.

4. Bench of limestones. The limestones are grey and yellowish-grey,

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organogeneous-fragmental,with interbeds at the lower part of sandstones .....70-80.0 m.

Above concordantly occur Konjakian deposits. The thickness of the described deposits in this section reaches I99-250 m.

S e n o m a n i a n a n d T u r o n i a n s t a g e s u n d i s s e c t e d

By the right bank of the Pashagol (Kalai-Murat) sai-approximately at the distance of 35 km. to the West from the village of Kalagai at the river of Surhab (fig.48,dr.57) with sharp azimuthal and angular unconformities on the sericite-chlorite-quartzy schists of lower Carboniferous age the following rocks are lying:

I. C lays greenish-grey,bluish-grey lumpy with frequent gravel and small pebbles of quartz ..... 0.3 m.

2. Limestones yelow fine-crystalline,leached..... 0.2 m.

3. Clays greenish-,bluish-grey schistose with thin interbeds of limestones being brownish-yellowish-grey,leached,thin-porous....I5.5 m.

4.Limestones light-grey,rusty-brown fine-crystalline with thin interbeds of clays beinf greenish-grey ..... I7.8 m.

5. Clays greenish-grey with rare thin (up to 0.5 m.) interbeds of limestones being brownish-grey fine-crystalline .....8.6 m.

6.Limestones brownish-grey fine-crystalline,massive .....I.6 m.

7. Clays greenish-,bluish-grey with interbeds (up to 0.3-I.0 m.) of limestones being greenish-brown organogeneous-fragmental;in the foot part of the section the clays contain gravell and pebbles of quartz and limestones ..... 24.4 m.

8.Limestones brownish-grey,aphanitic,in some interbeds with gravel ..... 2.5 m.

9. Limestones greenish-grey,brown with Inoceramus ex gr. hercynicus Petrasch.(lower Turonian) ..... 20.3 m.

Above with a break of continuty they are overlained by Maastrikht deposits. Total thickness of the undissected Senoman-Turonian deposits amounts 90.2 m.

27 km. further to the West,by the left slope of the Kainar sai (Ikm. downstream of the village of Sary-Kainar,fig.48,dr.56) above the schists of lower Carboniferous age,divided from them by three meters thick turfed strip,but apparently occurring with a sharp unconformity the following rocks are outcropping:

I.Limestones light-brown fine-crystalline,sandy,dolomitizated.... ..... 24.6 m.

2. Limestones brownish-grey,greyish-brown,micro-fine-crystalline .. .. 9.5 m.

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3. Marls olive-brown aleuritic .....4.9 m.

4. Marls brownish-green,olive,aleuritic ... .I2.8 m.

5. Sandstones red-brown,brownish-grey fine-grained,strongly calcareous,at the roof grading into gravellites with dissiminated small pebbles..... 8.4 m.

6. Limestones brownish-grey,greenish-brown fine-crystalline,in some lenses are sandy .. ..I3.I m.

7. Marls greenish-,brownish-grey aleuritic,micaceous with Inoceramus Sow.,"Nautilus" sp .....45.2 m.

8. Limestones light-brown,brownish-grey,fine-crystalline, sandy ..... 2.0 m.

They are overlined with a washout by Maastrikhtian deposits. The thickness of Senoman-Turonian deposits of the considered section reaches I23.5 meters.

Farther to the South-West,in the vicinities of the Doad(Tatar)-Doabi-Shakhpasand villages the Senomane-Turonian deposits with a washout occur on the Neokome-Aptian,Jurassic or Triassic deposits and with a wash out are overlined by Maaastrikhtian ones. Their thickness does not exceed 22-35 meters.

I0 km. to the West from the village of Madr (at the up-streams of the Sukhshar sai,fig.48,dr.55) the Senomane-Turonian deposits are represented by sandstones,schistose clays and limestones,which reach the thickness of 58 m.

With a small azimuthal and angular unconformity they occur on the red-coloured stratum of the Neokome-Aptian age and with a washout are overlained by Maastrikhtian deposits.

In the region of coaly deposit of the Shabashek,at the up-streams of the Taikhawol sai(near the village of Alimjan-Khan,fig.48,dr.54) on the weathered and white in the zone of weathering upper Triassic formations with a break of continuty occur clays,sandstones,gravellites,marls and limestones of the Senoman-Turonian age.They reach the thickness of 67.7 m and with a washout are overlained by Maastrikhtian deposits.

Analogical structure and composition have the undissected Senomane-Turonian deposits at the other places of their distribution. They reach the thickness from 20 m. (the right slope of the Alma(Chakhil) sai,5 km. to the South-West from the coaly deposit of Sari-Assya) up to I00-I20 m. (the left bank of the Darra-i-Suf,to the South-West from the coaly deposit of the Dakhani-Tor).

Besides the fossils in the described sections of the united and undissected Senoman-Turonian deposits the characteristic for Senomanian stage fossils are met:

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Praeradiolites cf.kugitangensis Bobk.,P.cf.tagarensis Bobk.,Gyropleura sp.,Apricardia douvillei Thomas et Peron subsp.,turkestanica Bobkova, A.cf.carantonensis Orb.,Trajanella rovikensis Djolilov,Plesioplocus karabakhensis Pcelincev,Actaeonella pcelintcevi Djolilov,Tylostoma sp.ind.

For the Turonian stage the following fossils are characteristic here: Hemiaster aff.blankenhorni Gauth.,Collignoniceras sp.,Acanthoceras s sp.,Arkhangelakiceras(?) sp.,Inoceramus aff. aplicalis Woods,I.ex gr. lamirski(non Park.) Woods var.ind.,Metaicoceras sp.,Placenticeras sp., Plicatula cf.batnesis Coq.,Terebratula sp.,Fatina (Avia) costei Coq., including microfauna: Anomalina vesca (N.Byk.),A.moniliformis v.moniliformis(Reuss),Valvulineria lenticula(Reuss),Nonionella cretacea Cushm., Bulimina reussi Morr.,Gyromorphina allomorphinoides (Reuss),Gyroidina nitida (Reuss),Gaudryna variabilis Mjatl.,Globigerina incauta Korch., Globigirinella aspera Ehrb.,Bolivina plaita Carsey.

Thus,the collected fossils confirm the Senoman-Turonian age of the considered deposits. They are concordantly occurring on the Albian formations(the region of the Puli-Khumri-Nakhrin) or with unconformity overlie at another places the Neokome-Aptian,Jurassic and more old formations. In turn they are either concordantly replaced by Konjakian deposits (the Puli-Khumri-Nakhrin),or with a washout overlained by Maastrikhtian ones.

The accumulation of the Senomane-Turonian deposits took place in th conditions of a shallow warm marine basin,which had continued transgessing to the South after a short-term stopping at the end of the Albian age. The transgression of a sea from the North took apparently place slowly and gradually,involving during the Senomanian age the most southern regions,being not occupyed in its time by the Albian sea.

The Senomanian sea had spread in the area with smooth plained relief to what testifyes the absence of coarse-fragmental sediments among the Senoman-Turonaian deposits.

K o n j a k i a n, S a n t o n i a n and K a m p a n i a n stages,undissected.

The undissected deposits of Konjakian,Santonian and Kampanian stages have a very limited distribution. They have been singled out in the strip from the Puli-Khumri up to Nakhrin,that is in the region of almost continuous sedimentation from Albian up to Paleocene. The describing deposits are represented by limestones,marls,clays,and aeurolites.

Limestones are of greenish-light-grey colour represented by aleuritic,sandy sometimes slightly glauconitic varieties. Usually they are aphanitic,rarely fine-crystalline. The rocks are massive or banded,with

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platy jointing. Sometimes met limestones, being brownish-grey, organogeneous-fragmental or coquinas. The latter have been coposed of large fragments of shells of oystres.

Marls are greenish-grey, greenish-brown are rarely met. The rocks are composed of fine-grained calcite-clayey aggregate, being platy, thin-banded.

Clays of green, dark-green, dark-grey, schistose, aleuritic, calcareous. They are predominant in numerous sections.

Aleurolites are greenish-grey, green, strongly-calcareous, often grading into limestones which are aleuritic.

In the region of PUli-Khumri the Konjak-Santon-Kampanian deposits have been represented by condordantly occurring on the Turonian stage series of clays, being of green, dark-green colour, slightly aleuritic, calcareous, with interbeds of limestones being yellowish-grey organogeneous-fragmental(fig. dr.5I). In the lower part of the series there developed aleurolites, being greenish-grey and green, calcareous, with interbeds of dark-green clays. The thickness of these deposits amounts 30-I40 meters. In them the following fossils are met: Hemiaster nucleus Desor., H. fourmeli Desor., Gryphaea navia Gabb., Liostrea minor Bobk., Inoceramus sp. (Makhnev A.M. and others, I962). With a slight washout, or without a noticeble unconformity they have been overlained by Maastrikhtian deposits.

To the East from the coaly deposit of the Dudkash (fig.49.dr.52) the section of these deposits, concordantly occurring on the Turonian ones, is completely composed of light-grey limestones, being fine-crystalline, aleuritic, reaching the thickness of 79 m. With the washout they are overlained by Maastrikhtian deposits.

To the South-East from the Dudkash (fig.49, dr.59) the section of Konjak-Kampanian deposits is somewhat different(Khatiskatsi G.N. and others, I963). On the Turonian deposits the following rocks are concordantly occurring:

I. Clays greenish-grey calcareous with Marsonella oxycona Reuss, Anomalina aff.moniliformis(Reuss), Cubicides sp., Inoceramus inconstans Woods ..... 39.5 m.

2. Limestones ..... 4.5 m.

3. Clays dark-grey, greenish-grey with interbeds of limestones, coquinas, and marls in the upper part of the section. In this bench the following fossils have been selected: Inoceramus cf.Kaenleini Mull., Fatina (Avia) Kugitangensis Bobk., Lopha dichotoma Bayle, Liostrea sp.ind. .....47.0 m.

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4. Limestones dark-grey organogeneous-fragmental with Ceratostreon spinosum Math.,Gryphaea vesicularis Lam.,Neithea quinquecostata Sow., Chlamys cf.sokolavae Bobk,,Chlamys sp.,Baculites sp. .....3-8.0 m.

5. Clays greenish-grey calcareous with interbeds of marls...28.5m .

The beds I and 2 are related to the Konjakian,the 3 rd.- to Santonian,the 4 th. and 5 th. - to Campanian stages. Total thickness of the described Konjak-Kampanian deposits,with a washout being overlained by Maastikhtian ones amounts about I27.5 m.

By the left bank of the Puli-Khumri river(Surkhab) immediately to the South from the town of Puli-Khumri (fig.49,dr.58) the Senoman-Turonian limestones are concordantly replaced by the following rocks:

I. Clays of green colour,being schistose,aleuritic,calcareous,with Hemiaster cf. fourneli Desh.,Liostrea rowvillei Coq.,Gryphaea sp., "Nautilus" sp.,Isocardia cf.babatagensis Babk. in the lower part of the bench,and with Fatina (Avia) cf.Kugitangensis Bobk.,Amphidonta sp.,Lopha sp.(aff.dichotoma Bayle); above by the section with six interbeds (up to I-2 m.) of limestones being brownish-grey,greenish-grey,organogeneous-fragmental..... up to 60-80.0 m

2. Marls of greenish-grey,brownish-pink colour,being aleuritic .. .. 3.0 m.

By the wavy boundary of a washout above occurs Maastrikhtian deposits. The thickness of the Konjak-Kampanian deposits of the described section reaches 83 m.

In the region of the village of Nakhrin (fig.49,dr.53) the analogical deposits being represented by greenish-grey,greyish-green limestones, sandstones,glauconitic or green clays with interbeds of organogeneous-fragmental limestones,with the total thickness being up to 40-50 m.

The y are concordantly occurring on the Senoman-Turonian stages and with a washout overlained by Maastrikhtian deposits.

Thus,the thickness of the undissected Konjakian-Santon-Kampanian deposits within the limits of a comparetively narrow area of their distribution ranges from 30 up to I40 m.,what is apparently connected with intensive wasout at the end of the Senomanian time in general.

In various outcrops of the considering materially clayey series besides the mentioned above fossils there also met the following: Micraster cf. turkestansis Schmidt (in the Konjakiand deposits),Fatina (Avia) cf. akkeptschigensis Bobk.,Inoceramus sp.,Modiolus sp. (in Santonian deposits), Discoscaphites aff.gibbus Schlut(?),Hemiaster sp.,and microfauna: Globigerinella aspera Ehrb,Monioninella Cretacea Cushm.,Gumbelina globigerina Reuss(in Kampanian deposits). Everywhere the Konjak-Kampaniand deposits concordantly replace the Senoman-Turonian ones and with a

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washout are overlained by the Maastikhtian ones.

The accumulation of the considered deposits took place in the conditions of a warm, shallow marine basin with more stable (as compare with the Senoman-Turonian) regime. One can suppose, that the sedimentation during the Konjakian, Santonian and Kampanian ages took place everywhere within the limits of the area being occupyed by the Albian-Turonian sea. However, in the western part of the area under description the Senomanian deposits had been completely washed out during the Pre Maastrikhtian or Maastrikhtian time as a result of the momentory uplifting of the country, as well as a result of active manifestation of erosional-denudation processes and further transgression of the Maastrikhtian sea.

M a a s t r i k h t i a n s t a g e

The Maastrikhtian deposits have the most wide distribution as compare with the described above subdivisions of the Cretaceous system. They are everywhere met, though they do not form large fields. Among the Maastrikhtian formations dolomites, limestones, marls, clays, aleurolites, sandstones, conglomerates and gypsums have been singled out.

Limestones have different colours: brown, pink, grey, green-grey, greyish-, yellowish-brown, sometimes spoty red-brown and have been represented by several varieties. Limestones aphanitic, dense, massive or unclearly-bedded and limestones organogeneous-fragmentla, thin-, and thick-beded, limestones with platy jointing or massive are widely distributed here. The first ones in more or less degree contain organogenic detritus, sometimes being slightly ferruginized. The second ones- are mainly composed of remains of coquinas, echinodermatas, fragments of shells of pelecipoda, gastropoda, brachippoda, being sunk into ground mass being micro-, fine-, or medium-crystalline of calcitic composition. The rock are often sandy, and contain grains of quartz, quartzite, feldspars or even an admixture of gravelly grains, aleuritic, clayey, clayey-sandy sometimes grauconitic. Limestones oolithic and microcrystalline, sandy, coquinas are more rarely met.

Marls have brownish-, yellowish, greenish-grey, rarely bluish-grey or cherry-pink colour. Usually they are thin-banded, rarely massive rocks with platy jointing.

Dolomites are yellow-grey or grey, dolomitizated limestones are met in some sections only, where they form thin interbeds. They are thick-laminated or massive rocks, being dense and hard, rarely loose.

Clays are green-grey rarely red-brown being in subordinated position. These rocks are calcareous, with separate small crystalls and growths of transparent gypsum, sometimes being ferruginized. Structure of these rocks is fine-lumpy, foliated or platy; sometimes the rocks are schistose,

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argillite-like. Under a microscope a clasic fabric of clays can be seen, sometimes lamination is observed. In the groud pelitic mass singular aleuritic grains ofquartz, feldspars, flakes of muscovite, and chlorite are met.

Aleurolites are met of grey, greenish-grey, red-brown colour. Fine- and coarse-grained varieties are singled out, also laminated and platy ones. The rocks are calcareous. They have been composed by grains of quartz, feldspars, flakes of muscovite and chlorite.

Sandstones are of light-grey, grey colour, sometimes being laminated, brown-grey and are represented by inequi- coarse-, and fine-grained varieties. The rocks are strongly calcareous, often grading into sandy limestones. Cross bedding can be sometimes observed in them. In the composition the sandstones are oligomictic, materially quartzy. Besides quartz grains of alterated feldspars, quartzite, flakes of muscovite, chloritizated biotite, chlorite are met. Grains are semi-rounded, rounded, rarely angular. C ement is calcitic or clayey-calcitic, basal or porous. Loose and densely cemented rocks are met.

Conglomerates are of light brownish-grey colour ~~xrx~~ met in singular sections. They have been composed by small and medium pebbles, being medium-rounded, medium-sorted, cemented by sandy-calcareous-clayey cement. In pebbles met quarz, hornfels, metamorphic rocks, limestones. Gravellites being also very rarely met have been composed of well rounded and sorted grains of quartz.

Gypsums are of white colour, being of lumpy fabric, by branching net pearcing through clays and form separate small (up to 0.I m.) lumps. Sometimes they have been elongated by separate horizons, rarely composing beds, the thickness of which being up to 8 m.

The structure of the Maastrikhtian deposits is characterised by the following sections:

By the right slope of the Kalai-Murat sai (approximately 35 km. to the West of the village Kalagai at the river of Surkhab) on the Senoman-Turonian deposits, apparently with a washout the following rocks are occurring (fig.50, dr.57):

I. Clays of green colour with interbeds (up to 0.5-I.0 m.) of limestones being fine-crystalline or aphanitic with Gryphaea vesicularis Lam., Terebratula sp. .....I9.7 m.

2. Clays of green, greenish-grey colour, saturated by gypsum I5.8 m.

3. Limestones greyish-brown aphanitic ..... I5.6 m.

4. Limestones greenish-brown microcrystalline..... I0.6 m.

5. Limestones yellowish-brown aphanitic lumpy ..... I7.0 m.

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Above a turfed slope (I7 m.) is traced above which in the form of scarp massive limestones of Dat-Paleocenian stages have been exposed.

The thickness of the described Maastrikhtian deposits exceeds 78.7 meters.

By the right slope of the Doab river(Tangi) to the East from the village of Doabi-Shakhpasand on the Senoman-Turonian deposits with a washout occur limestones and marls of Maastrikhtian stage,with the thickness being 94.0 m. They are concordantly replaced by limestones of Dat-Paleocenian age.

In the vicinity of the Puli-Khumri town (fig.50,dr.5I) with a washout or without a noticeable unconformity on the Konjak-Santon-Kampanian deposits occur (Makhnev A.M. and others,I963) limestones of light-grey colour,in some parts being brown or pink coloured with a bench of marls and clays of greenish-grey colour with interbeds of coquinas. There are the following fossil met: Spondylus sp.indet.,Gyropleura laevis Holz. var. soluni Bobk.,Spatagoides striato-radiatus Leske,Ceratostreon spinosum Math. var. malikensis Mur., Radiolitidae.

Total thickness of the described deposits amounts 65-70 m. Above the section they conformably are replaced by the Dat-Paleocene formations.

In the area of the Dudkash coal deposit (fig.50,dr.59) is described (Khatiskatzi G.N. etc., I963) the following section of the Maastrikht, with the fracture of washing out,being layed on the Coniak-Campan.

I. Limestones sandy with fine pebble of quartz,substituted by sandstones.In the upper part are met Biradiolites boldjuanensis Bobk....45.0m

2. Limestones whitish-grey dolomitisised,mealy with Praeradiolites aff.scharobdariensis Bobk..... .73.0 m

Being replaced by the Dat-Paleocene deposits the Maastrikht has here thickness of II8 m.

In the same area is observed somewhat different section of the Maastrikht (fig.50,dr.52) with visible thickness of 86 m ,composed by limestones and clays.

In the area of the Ishpushta coal deposit (fig.52,dr 6I) at conglomerates of the Neocom-Apt with washout occure:

I.Limestones yellowish-grey sandy with mixture of gravel material, organogene-fractured interbeds.....28.0 m

Aleurolites red-brown-red calcic with limestones,aleurolitic in the basement..... .....I9.I m

3.Conglomerates greyish-brown-red fine-middle-pebbled.....2.8 m

4.Aleurolites red-brown-red coarse-grained with conglomerate lenses

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in the basement..... .....I4.0 m

5.Gypsum white lumpy with lenses of red-brown-red aleurolites 8.Im

6The interstratification of sandstones grey gypsum and red-brown--red aleuritic clays.....8.6 m

7.The interstratification of grey alerites,grey aleuritic gypsum clays and white gypsums..... I0.4 m

8.Clays grey,black-wine-coloured schistous aleuritic,gypsum with interbed of (2.4 m) gypsum white in foot.....I0.2 m

9.Dolomites yellowish-grey with interbeds of clays greenish-grey aleuritic,gypsum,with lenses of white gypsum in roof.....I5.9 m

I0.Limestones grey dolomitisised,dense in the low and soft in the upper part.....I4.0 m

Above conformably lay the Dat-Paleocene deposits (fig.5I).The thickness of the Maastrikht in the considered section reaches I3I.I m.

In the area of Andau village (the Kamard river in 8 km to SE from Madr village) with outwash on the Neocom-Apt deposits lay(fig.52,dr.60):

I.Limestones red-brown,pink-red organogene -fractured 20.0m

2.Sandstones grey calcic with interbed of schistous clays;at foot they interfer to limestones sandy.Microfauna:
Spiroplectammina sp.,Gyroidina sp.,Cibicides sp.?,C.ex gr.voltxianus (Irbygni),C.bembix Marss.....7.5 m

3.Limestones greenish-grey sandy lumpy.....5.5 m

4.Limestones grey organogene-fractured,in the upper part sandy20.3m

5.Limestones pink fine-oolite with gravel material.....2.0m

6.Clays red-coloured aleuritic.....6.5 m

7.Limestones grey sandy .....8.0 m

8.Limestones grey,yellowish-grey,lumpy Spondylus sp.ind.,Gryphaea vesicularis Lam.,G.vesicularis Lam.var.similis Push,Exogyra cf.ostracina Lam.,Nethea cf.simbirskensis Orb.,Ceratostreon spinosum Math.var.malikensis Muraf.,Amphidonta ex.gr. aralensis Arkh,Spatagoides sp.....6.0m

9.Limestones dark-grey sandy.....6.5 m

I0.Limestones grey sandy and sandy with stonenesses,analogical to the described in bed 8.....5.5 m

II.Limestones greenish-grey clayey,aleurolitic with stonenesses, analogical to the described in bed 8.....5.7 m

I2.Limestone-coquina grey,greenish-grey,sandy.....I.2 m

I3.Limestones greenish-grey dolomitisised clayey.....5.5 m

Above conformably lay the Dat-Paleocene deposits.Thickness of the Maastrikht reaches I02 m.

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In IO km to the West from Madr village (Surkhshar sai uppers) with outwash at the Cenoman-Turonian deposits occure (fig.52,dr.55) limesto with interbeds of sandstones,clays and marls withabundant Maastrikht fossils(Ceratostreon spinosum Math. var.malikensis Muraf.,Neithea aff.substriato-costata Orb.,Gryphaea vesicularis Lam.,G.vesicularis Lam.var.similis Push.).By thickness they exceed 89 m and conformably are replaced by limestones of the Dat-Paleocene.

The given results show a comparatively persistent thickness of the Maastrikht deposits,sometimes reaching and even exceeding I00 m.

The enumerated while describing the sections of fossils as well as having been found at the analogical deposits Echinocorys cf. pyramidatus Port.,Echinocorys sp.,Inoceramus ex.gr.regularis Orb.,Terebratula sp.,Neithea aff. simbirskensis Orb.,Lopha(Arctostrea)tadjikistanica Bobk.,Orbygnia aff.vlasovi Bbok.,Radiolites sp.ind.,Biradilites cf. boldjuanensis Bobk.,Praeradilites sp.(aff.schurobdariensis Bobk. Cardium sp.,Chlamys ex gr.dujardini Roem.,Lopha(Arctostrea)falcata Mort.,Echinocorys ex gr.ovatus Leske,Modiolus sp.,Neithea aff.quinquecostata Sow.,Carneithyris sp.,Echinocorys aff. ciplyensis Lamb.,Gryphaea aff.pitcheri Mort.,G.aff.adunca Vinok.,Fatina(Avia) sp.,Carneithyris aff.carnea Sow.,Salenia sp.,Praeradiolites sp.(aff.simakovy Bobk.),Exogyra ostracina Lam.,E.cf.lacinata Nils. characterise enclosing them formations as the Maastrikht.

The accumulation of the Maastrikht deposits took place in warm shallow sea basin .In view of the fact that the detail paleonthologic analysis of the collected fossils was not carried out it is very difficult to speak of the completely developed Maastrikht deposits in the investigated area.However,in the northern-western part of the country,at the Selsela Kokh-i-Band-i-Baba distinctively is fixed the inner Maastrikht outwash. On the fauna characterised Maastrikht deposit with stratigraphical unconformability lay the deposits of the upper part of the Maastrikht,in the adjacent areas little by little complete cutting the cretaceous deposits and being located with considerable azimuth and angle unconformities at the Triassic formationsMichailov K.Ja. and others.,I965).

Oneshould be noted another picture of the development of large squares of Northern Afghanistan (Bratash V.I. and others,I964)located to North-West from the investigated area . There the sedimentation in the Upper-Cretaceous sea is broken at the middle of the Campan age and starts a new transgressive cycle by the Upper-Campan deposits conforma

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bly changed by Maastrikhtian deposits. It is qiute probable, that the same break of continuty is ment here now, being somewhat different in time for separate areas of the northern Afghanistam.

D a t - P a l e o c e n e s t a g e s
j o i n t

The Dat-Paleocene deposits are the most widely distributed on the investigated territory, composing vast fields within the limits of the interstream areas(fig.53) involving the area of about 4000 sq.km. They have been represented by lithologically monotonous series of limestones, rarely of dolomites, marls and clays.

Limestones are coloured in light tints. They are light-grey, brownish-grey, light-brown, raraly pinkish-brown, grey, bluish-, greenish-grey rocks. Often they are massive, unclearly-bedded or coarse-bedded, rarely medium-, and thin-bedded, sometimes with platy jointing. Limestones being crypto-crystalline, or thin-crystalline, dense, hard, with shell-like fracture, sometimes containing pipe-like concretions of silicon are the most widely distributed. Organogeneous-fragmental, sandy, clayey, dolomitizated, glauconitic limestones are also met. Sometimes the rocks are white, massive, porous. Algae limestones are also met. At some places the rocks have brecciated appearence. For all the rocks the phenonena of granulation or recrystallization are characteristic.

Dolomites are of grey colour. They are fine-crystalline, thin-, and medium-grained rocks, sometimes contaning lumps and interbeds of gypsum. The rocks are sparkling in the sun, and they are dense. They compose separate interbeds, sometimes benches with the thickness up to 50 m.

Marls are light pinkish-grey, or white colour. They are often massive, soft, viscose rocks with lumpy or irregular-platy jointing, sometimes being bedded, platy, hard, ringing. In marls lenses and interbeds of silicon are met. Marls are met in separate interbeds, only in separate sections composing benches up to I00 m.

Clays are of dark-grey colour, calcareous, schistose, lumpy are met in separate thin interbeds,

The Dat-Paleocene deposits are everywhere finishing the section of the carbonaceous series of the Cretaceous age, often screening the recent positive forms of relief. The notion on the structure of the formations under consideration provide the section observed to the East from the town of Puli-Khumri (fig.54., dr.52). Concordantly replacing the Maastrikhtian deposits the following are exposed:

I. Limestones of brownish-grey colour, micro-, and crypto-crystalline ..... 37.5 m.

2. Limestones brownish-grey clayey porous..... 4.0 m.

3. Interstratification of white and grey massive marls.....47.0 m.

4. Limestones spoty grey cryptocrystalline..... 3.0 m.

5. Interstratification of white anf grey marls, in some interbeds being pink ..... 92.0 m.

6. Marls white, massive, viscous..... I2.0 m.

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7. Marls pinkish-grey dense hard ..... . I6.0 m.

8. Interstratification of marls being dense hard and soft, viscous ..... 28.0 m.

9. Limestones grey clayey ..... . 8.0 m.

I0. Marls of white colour ..... 42.0 m.

II. Limestones light-grey aphanitic with Cardita (Venericardia) cf. Pentuncularis Lam ... apparent thickness is ..... 36.0 m.

I2. The bed II is armouring the surface of quest. The thickness of the deposits of the adduced section reaches 325.5 meters.

In the visinity of the Puli-Khumri town another one section of the formations under consideration has been described(Makhnev A.M. and oth. I962). On the Maastrikhtian deposits the following ones are occurring(concordantly):

I. Limestones light-grey,yellowish-grey,organogeneous-fragmental with interbeds of dolomites in the lower part .....I30.0 m.

2. Limestones light-grey,white dolomitizated,at some places being organogeneous-fragmental with Lucina cf. microdonta Desh.,Nemocardium edwardsi Desh.,Gari consobrina Desh.,G. edwardsi Morris,Cyprina lunulata Desh.,Dosiniopsis fallax Desh.,Cyprina scuttellaria Lam.,Dosiniopsis fallax Desh.,Cyprina scuttellaria Lam.,Dosiniopsis ucrainicus Mir.,Ostrea ex gr. gigantica ..... 350.0 m.

Above concordantly occur the Suzakian deposits.The thickness of the Dat-Paleocene deposits reaches here 480 m.

In the region of the coaly deposit of the Shabashek,near the village of Alimjan-Khan (fig.54,dr.54) on the Maastrikhtian deposits the following ones are concordantly occurring:

I.Limestones grey clayey,at the basement being glauconitic with Echinocorys aff. sulcatus Goldf.,E.aff.pyrenaicus Seunes .....II.4 m.

2. Limestones grey glauconitic with concretions of silicon II.9 m.

3. Limestones yellowish-,light-,dark-grey,thin-bedded .....I7.5 m.

4. Limestones grey aphanitic with rounded and pipe-like siliceous concretions ..... 56.2 m.

5. Limestones brownish-,light-grey clayey with concretions of silican at the roof ..... I9.2 m.

6. Marls greenish-grey with lenses of silicons with Cyclothyris sp.ind.,Gryphaea sp ..... 20.0 m.

7. Limestones greenish-grey organogeneous-fragmental and cryptocrystalline with fossils,amalogical to those described in the bed "6".. .....I9.0 m.

8. Limestones grey massive .....I6.0 m.

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9.Limestones grey,blmish-grey massive .....24.0 m.

IO. Interstratification of greenish-and bluish-grey limestones, being clayey and glauconitic with Hemiaster sp.,Echimocorys sp.,the apparent thickness is ..... 65.0 m.

The bed IO finishes the surface of a cuesta. The apparent thickness of Dat-Paleocene deposits amounts 260.2 m.

In the region of the Andau village (the Kamard river,fig.54,dr.60) on the Maastrikhtian deposits concordantly occur limestones with interbeds of dolomites,with lumps of gypsums,the apparent thickness being above 346.8 m.

In the region of coaly deposit of the Ishpushta on the Maastikhtian deposits the following ones are concordantly occurring:

I. Limestones white dolomitizated,porous,massive ..... I54.6 m.
3. Limestones grey organogeneous-fragmental..... 75.5 m.
2. Limestones grey dolomitizated massive ..... 20.0 m.
4. Limestones grey lumpy ..... I0.0 m.

Total thickness of the Dat-Paleocene deposits (which concordantly underlie the Suzakian ones) reaches in this region 260.I m.

By the left bank of the Lela sai(the left tributary of the Darra-i-Suf river,fig.54.,dr.63) the surface of a cuesta and the section of the Cretaceous age finish the concordantly lying on the Maastrikhtian deposits,limestones and marls of the Dat-Paleocene age with the thickness being above 353.I m.

In the most number of the regions the Dat-Paleocene deposits finishing the section of the Cretaceous age,armouring the positive forms of the relief and being in more or less degree washed out. For example,by the right bank of the Tangi river(up-stream the village of the Doabi-Shakhpasand) their apparent thickness amounts only about 40 m.,by the right slope of the sai Kalai-Murat - about 200 m. However,to the West from the village of Madr the Surkhshar sai cuts the occurring on the Maastrikht and overlained by Suzak the Dat-Paleocene deposits with the thickness of the latter being above 600 m.,and in the region of coaly deposit of Dakhani-Tor they are exceeding 700 m. Thus,at three places,where the section is observed in the most complete volume,the thickness of the Dat-Paleocene deposits amounts not less than400-600 m. The lower part of the described deposits is lithologically clearly distinguished from the undelying Maastrikhtian formations and contains usually extreamely poor fossils. Only in the upper part of the section the fossils being characteristic for the Tanetian stage are met: Ostrea gigantica Sol.,Gryphaea cf. antiqua Schewetz.,G. antiqua Schwetz.,G. cf. gigantica Sol.,G.gigantica Sol.var.ind.,Cucullaea sp.(aff. crassatina Lam),Lucina sp.,Nemocardium sp

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Terebratulina aff.bisinuata Conrad,Cyprina cf.morrisi Sow.,C. cf.scutellaria Lam.,Pectunculus sp.,Pleurotomaria tajikistanica Miron. var.ind., Cardita aff.ferganica Mironova,Pectunculus cf. terebratularis Lam.,Corbula aff. angulata Lam.,Amphidonta (Gryphaeostrea) oversa Mellev,Gryphaea aff. tourali Dono.,Cucullae sp.,Cyprina excellans Harb.,and others

As the described deposits are concordantly and continuously occur between the Maastrikhtian and Suzakian stages,including the mentioned fossils,they are related by us to the joint Dat-Paleocene stage.

The described carbonaceous series had been accumulating in the conditions of opened shallow marine basin,undergoing slight downwarping, being compensated by sedimentation of thick and monotonous carbonaceous deposits. During some short-termed periods of time the downwarping of the bottom was decreased and then within the limits of these areas of relative up-lifting dolomites and gypsums had been accumulated. By the end of Paleocene the downwarping of the area was gradually decreased.

P A L E O G E N E S Y S T E M

Paleogene deposits(excluding Paleocene) have been distributed within the limits of the investigated territory in very limited scale. They compose small fields in the marginal North-Western and South-western parts of the region- by the river Chakhar-Dekh(Darrai-Suf);more vast areas at the down-streams of the Kamard river,narrow strips -to the East from the town of Puli-Khumri,separate outcrops - to the West and South-West from the village of Ishkamysh(near the villages of Tangi-Muruch,Ak Chashma, Tersak Chashma).

Paleogene deposits(excluding Paleocene)described above,in the composition of the joint Dat-Paleocene formations)are represented by Eocene, and possibly by Oligocene (fig.55). The latter is present in the Shafai series of the upper Oligocene-lower Miocene.

The Paleogene deposits together with the underlying them Cretaceous ones have been folded,the folds being plained,sometimes box-like or flexure-like;they occur very gently,only near fractures having steep dipping.

With a washout and with a slight unconformity on the Turkestanian (or more old) formations occur the deposits of the Shafai series,being more slightly dislocated and forming gentle brachiform folds.

E o c e n e

On the investigated territory the Eocene deposits are subdivided

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into Suzakian and undissected Alaian and Turkestanian stages. Among them the Suzakian deposits are the most widely distributed,which are met in the western,central(the most lafgefields) and in the eastern parts of the territory,while the Alaian and Turkestanian stages form small outcrops in the eastern part of the region only.

L o w e r E o c e n e. Suzakian stage

The Suzakian deposits have been represented by limestones,marls,clays,sandstones,gypsums,sometimes among them celestine is met.

Limestones are of grey,brownish-grey colour,usually being strongly sandy,gradually grading into sandstones,being fine-grained,strongly-calcareous,olygomictic(grains of quartz,rarely of feldspars,quartzite,flakes of muscovite). The sorting and roundness of the grains are well.The limestones are massive or thick-banded,composing interbeds with the thickness up to 0.I-I5 m. among clays. Bituminous limestones are also met, as well as limestones aphanitic containing rare recrystallized organic remains.

Marls are of brownish-grey,light-grey colour,dense,ringing,thin-laminated,having thin-platy jointing. They compose singular thin interbeds being sometimes strongly saturated with gypsum.

Clays have grey,olive-,greenish-,yellowish-grey colour,being singled out as schistose rocks,they are argillite-like,fine-lumpy foliated or thin-platy,sometimes viscous,fat. All the varieties are strongly calcareous,sometimes aleuritic,sometimes strongly saturated with gypsum(veinlets and dissiminated crystalls of gypsum). The observed bedding is sometimes connected alternation of separate thinnest interbeds with different contents of carbonaceous and clayey substance. In the clays a fish flake rarely organic detritus are met.

Gypsums are of white colour,granular,sometimes contain crystalls of smoky transparent gypsums or thin interbeds,composed by transparent crystalline gypsum(in the ground mass). They form separate beds with the thickness up to 30 m. They are met in the form of veinlets,cutting trough clays also.

Celestine is met in the form of growths of water-transparent or of pale-blue crystalls,or in the form of cryptocrystalline mass,forming thin interbeds among limestones and gypsums.Crystalline celestine is met in small geodes(up to 5-I0 cm. in diameter), being observed in the ground mass composed by celestine or carbonate-celestine mass. Together with celestine small crystalls of native sulphur are met. In separate interbeds celestine is cementing sharp-angular fragments of limestones. It is probable that in the form of fine-dissiminated admixture in the celestine mass barite is present*).

To the East from the town of Puli-Khumri,by the right slope of the Saie-Beshhazd sai(Kaukpar-Nakhrin) the following section of the Suzakian deposits (fig.56,dr.64) can be observed; the Dat-Paleocene limestones without a noticeable unconformity sharply replace the following:

I. Gypsums of white colour with interbeds of smoky crystalline gypsum ..... 4.0 m.

2. Limestone saturated with gypsum,of light-grey colour with crystalls of gypsum ..... I.0 m.

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3. Marls of grey colour,saturated with gypsum .....I.0 m.

4. Clays bright-yellow,fat,lumpy .....0.I m.

5. Marls light-grey thin-laminated ... .7.0 m.

6. Interbedding of grey and olive-grey clays being schistose,and clays being aleuritic. Rare interbeds (up to 0.2 m.) of light-grey,pinkish-grey marls. Regular interbeds (in I-I.5 m. with the thickness up to I cm.) of grey crystalline gypsum. In the roff of the section the following microfauna,being characteristic for the intermediate beds from the Suzakian to Allaian stages had been selested: Rotalia heskeri N.Byk., Libicides lunatus (Brotzen), Globigerina bulloides Pl.,Globigerina triloculinoides Pl.,Globigerina varianta Subb.

8 m. down the section the following fauna had been found: Cibicides ex gr.lectus Vass.,C. ex gr. suzakensis N.Byk.,Globigerina trilaculinoides Pl.,G. varianta Subb.,Bulimina ovata Orb.;25 m. below the roof : Globigerina pseudobulloides Pl.,G.triloculinoides Pl.,Acarinina pentacamerata (Subb.) ..... 60.0 m.

Total thickness of the Suzakian deposits here amounts 73.I meters.

Above with a gradual grading occur the Allaian deposits.

To the North from the Nakhrin village,near the village of Tangi-Muruch(fig.56.,dr.65) on the limestones of Dat-Paleocene stage occur the following rocks:

I. Marls yellowish-,greenish-grey,platy .....from 2 up to I4.0 m

2. Limestones grey bituminous ..... up to I2.0 m

3. Celestine with interbeds of bituminous limestones.Along the strike replaced by gypsums or calcareous breccias,cemented by celestine... ..... 0.3-3.0 m.

4. Limestones of grey,dark-grey colour,thinplaty ..... 5.0 m.

5. Clays greenish-grey,argillaceous,aleuritic with interbeds of sandstones being finegrained calcareous ..... above 50.0 m.

Total thickness of the Suzakian deposits (concordantly replaced by Allaian) exceeds in the section mentioned above 84 m.

By the right slope of the Darra-i-Siwak sai (the right tributary of the Kamard river,fig.57,dr.67) on the Dat-Paleocene limestones by a sharp boundary but without noticeble unconformity the following rocks are lying:

I. Limestones pink,grey,organogeneous-fragmental,at the roof grading into sandstones finegrained glauconitic .....0.3 - 0.7 m.

2. Clays grey aleuritic,saturated with gypsum,foliated. They contain the following microfauna: At the basement: Acarinina pentacamerata (Subb.) A. Subsphaerica (Subb.),Cibicides sp.(ex gr.incognitus Vass.); 2 m. above the basement: Robulus infrasusakensis N.Buk.,Nodosaria,Gyroidina ex gr.soldnil Orb.,Stensioina whitei Moroz.,Anomalina ekblomi (Brotz.),Cibicides sp.n

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(ex gr. incognitus Vass.),Acarinina pentacamerata(Subb.),Globigerina triloculinoides Plumm.,Bulimina ovata Orb.; at the interval 4-I0 m. above the basement: Clavulina farafraensis (La Roy), Paragaudryna gygantica (Subb.),Gyroidina ex gr.soldanii Orb.,Stensioina whitei Moroz.,Anomalina ekblomi (Brotzen),A. granosa (Hantken),Cibicides (ex gr.incognitus Vass.), C.lunatus (La Roy),C. suzakensis N. Byk.,Angulogerina wilcoxensis (Cushm. et Pont.),Acarinina pentacamerata (Subb.),A. subsphaerica ((Subb.),Globigerina triloculinoides Plumm.,Globorotalia crassata Cushm., G. tadjikistanensis N.Byk.,Bulimina ovata Orb.; at the interval I2-I6 m. above the basement : Acarinina pentacamerata (Subb.),Acarinina subsphaerica (Subb.),Globorotalia crussata Cushm..... 2I.0 m.

3. Clays light-brown,calcareous,foliated,with frequent interbeds (2-30 m.) of white gypsum and singular interbeds of clayey limestone and dolomite. Rare microfauna of Acarinina pentacamerata (Subb.),Nomion sp. Anomalina sp. .....up.to I00-I50 m.

4. Gypsum white,light-yellow with interbeds of dolomites being thin-platy and bituminous at the middle part of the section.... 25-30 m.

5. Aleurolites grey calcareous,clayey .....30-40 m.

6. Sandstones light-grey fine-grained calcareous ..... II m.

7. Limestones sandy clayey ..... 3.0 m.

Above with a washout occur the deposits of Miocene. Total thickness of the Suzakian deposits here reaches 255.7 m.

Alike by the character section is observed also near the village of the Dashti-Safed(the left bank of the Kamard river,fig.57,dr.66),where Suzakian deposits with a washout being overlained by Miocene,have the thickness above I34.0 m.

By the left bank of the Kamard river(in the vicinity of the Madr village,fig.57,dr.68) on the Dat-Paleocene limestones without noticeble unconformity occur the following rocks:

I. Limestones grey fine-crystalline strongly sandy,grading into sandstones being strongly calcareous,usually bituminous. Along the strike they have been replaced by clays of greyish-green colour with interbeds of analogical sandstones ..... up to I0-20 m.

2. C lays grey,greenish-grey,schistose,saturated with gypsum,grading into marls which are clayey ..... about I00 m.

3. With a washout and azimuthal (up to 60°) and with angular(up to 8°) unconformities the following rocks are occurring on them:

3. Limestones grey,brownish-grey fine-crystalline,sandy at the base ment contain small rounded lumps of clays .....I2-30.0 m.

4. Clays of grey colour schistose or foliated ..... above 50.0 m.

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The described above series with a washout is overlained by Miocene, being in the thickness above 200 m.

The thickness being quite monotonous in its structure in all the outcrops of the Suzakian deposits is increasing to the North and especially to the West from the town of Puli-Khumri from 73 up to 130-200 m.

The adduced lists of fossils,as well as the situation in the continuous section above the Paleocene and Alaian stages of Eocene all this allows to speak with confidence about the Suzakian age of the considered above deposits.

The sedimentation of the deposits took place in a warm shallow marine basin. In some regions the sedimentation continued to deposit formations of the Dat-Paleocene sea; the only providing of fine-fragmental material was encreased; in another regions - the appearence at the base of the section of celestine,sulphur as well as of bituminous rocks,all these facts speak about the possible contamination of the basin by sulphide hydrogene. Common gypsum-bearing of the Suzakian deposits testifies to the decreasing of speed of downwarping of the marine bottom,also to closing of the basin,to the appearence of lagoone conditions in its vast parts. Sometimes separate parts of the basin underwent the locally encreased downwarping and acquired for some time depp-water conditions(to what testifies the complex of foraminiferas),what was quickly compensated by the accumulation of clayey sediments. At the end of the Suzakian age the marine basin (at least in the vicinity of the Madr village) underwent the fluctuation of the level,at some times even washing out of sediments took place. The accumulation of deposits at the end of the Suzakian age took place at least in the north-eastern part of the territory,-in the conditions of continued shallowing of the sea,that is of its regression.

M i d d l e - Upp p e r E o c e n e.

Allaian and Turkestanian stages,undissected

Small outcrops of the Allaian and Turkestanian deposits are known at three places only: to the East from the town of Puli-Khumri,Epo,sai of Kaukpar-Nakhrin and by the western bort of the Ishkamyshian depression; near the village of Tangi-Muruch and the village of Tersak Chashma. They are composed by clays,limestones and conglomerates.

Clays are met of light-grey colour,schistose,calcareous,aleuritic, micaceous,with fine-lumpy jointing. Lilac-grey,red-brown, satureted with gypsum,aleuritic clays are also known.

Limestones are of light,yellowish-grey colour have been represented

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by organogeneous-fragmental varieties. They are either fine-detrital rocks or coquinas. They usually contain an admixture of sandy grains of quartz and feldspars.

Conglomerates have brownish-grey,red-brown colour. They have been represented by fine-,meduim,or inequigranular varieties,composed of well rounded and medium-sorted pebbles of limestones,quartz,siliceous rocks. Cement is sandy-clayey or clayey-carbonaceous.

By the right slope of the Saie-Beshhazd(Kaukpar-Nakhrin) the following section of the Alaian and Turkestanian deposits can be observed(fig 56,dr.64). On grey clays,containing complex of Suzakian foraminiferas with some Allaian forms (intermediate beds from Suzak to Allaian stage) concordantly occur the following deposits:

I. Interstratification of limestones being fine-detrital and coquina with ferrirerous concretions(interbeds have the thickness up to 0.5 m.). Teeth of sharks are also met..... 2-4.0 m.

2. Clays light-grey(above they are grey),schistose,micaceous, strongly calcareous ..... 2.0 m.

3. Clays lilac-grey,loose,saturated with gypsum .....3-6.0 m.

4. C lays red-brown,red-fallow,aleuritic with an admixture of sandy-gravelly material,slightly gypsum-bearing .... 8-I4.0 m.

5. Conglomerates brownish-grey ..... 3.0 m.

6. Conglomerates red-brown sandy-gravelly .....I0.0 m.

7. Clays red-brown aleuritic with sandstones being fine-grained, medium-grained at the basement and with interbeds of conglomerates.... .....I2.0 m.

8. Conglomerates red-brown..... 3.0 m.

9. Limestones clayey-lumpy ..... I.5 m.

Above apparently with a washout(the contact is not observed) occur Rustakian deposits of Pliocene. Total thickness of the undissected Alaiand and Turkestanian deposits reaches here 55.5 m.

Near the village of Tangi-Murush (fig.56,dr.65) the Suzakian deposits towards the upper part of the section concordantly replaced by party coloured series of terrigeneous-clayey composition. It has been composed of interstratificating green-grey,red-brown,cherry-red clays with gypsums,containing interbeds of light-grey sandstones being calcareous,of conglomerates being fine-pebbly and of marls. In the lower and upper parts of the section the following fossils are met: Ostrea turkestanensis Rom.,O. turkestanensis Rom. var. baissunensis Bohm., O. turkestanensis Rom. var. alaica Vial.,O.afghanica Vial.,O, multicostata Desh., O. turkestanensis cizancourti.

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With a washout they are overlained by Pliocene, reaching the thickness of about 80 m. Near the village of Tersak Chashma from under the cover of loese-like loams separate fragments of Alaiand and Turkestanian undissected deposits are appearing. At the lower part of the section interbedding grey-green and brickly-red clays or sandy, viscouse, lumpy clays the apparent thickness of which being about 40 m. In separate interbeds the Alaian fossils: Ostrea Turkestanensis Rom. var.alaica Vial. are met. Approximately 30 m. towards the upper part of the section clays being red, with the apparent thickness up to I m., changing at the upper part of the section by grey-green sandy, lumpy with the thickness about 2 m. In their middle part there is an interbed (0.05 m.) of less sandy clay which contains abundant fragments of Fatina esterhazyi Pav.? (turkestanik form); on clays occur grey loose conglomerates, with the apparent thickness being above I m.

The Alaian deposits have been accumulated in a shallow marine basin separated into lagoons (gypsum-bearing of sediments) which apparently was abundant with islands, from which terrigeneous material was coming. Alaian deposits have been represented by near-shore and shallow facies. Taking into consideration the phenomenon of this marine basin one can suppose that it did not spread for the western part of the investigated territory. However, there are no determined data in fovour of this assumption, as everywhere to the day surface come the washed out Dat-Paleocene deposits, (sometimes in the northern part of the region), being overlained by Neogene.

The sedimentation during the Turkestanian age took place in the conditions of shallowing shallow marine basin on the backgroud od apparently general uplifting of the whole territory. In connection with it the washing out of the uplifted areas was encreased and the coming of fragmental material into the basin of sedimentation was also encreased.

To the North from the investigated area the Alaian and Turkestanian deposits have more wide distribution. The Alaian stage has been composed of analogical to the described above clays, marls, limestones, sandstones, reaching the thickness of 28-I30 m. The Turkestanian deposits have been represented by clays and aleurolites with interbeds of sandstones and limestones, the thickness being 22-I40 m. (Bratash V.I. and others, I96I), that is to say by fine-fragmental or even carbonaceous sediments in general, being apparently sedimented still not in the marginak, but in the central part of the marine basin.

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Upper Oligocene-Lower Miocene

Shafai series

The deposits describing below have been distributed exclusively in the North-eastern part of the investigated territory, in general composing small fields, exposing from under more yuong formations. The Shafaian deposits have been represented by clays, sandstones, conglomerates, partly - by limestones.

Clays are of brown, light-brown, red-brown (from beyond-red) colour. The rocks are calcareous, dense, hard, massive, often contaning an admixture of sandy-gravelly material and dissiminated small pebbles of limestones. Olive-green soft clays are met in some lenses. Sometimes the clays are aleuritic, grading into aleurolites being clayey. The clays are the predominant in the section.

Sandstones are of greenish-brownish, brownish-grey, fine-, and medium-grained, polymictic, are met in singular thin interbeds. The composing them angular (rarely semi-rounded) grains of quartz, limestones (sometimes being ferruginized), limonite, flakes of chlorite are cemented by basal calcite mass.

Conglomerates of brownish-grey colour, inequi-pebbly, usually being com posed of pebbles(well and medium-rounded and poorly sorted) of Cretaceous and Jurassic limestones. More dense and hard varieties, with clayey -carbonaceous cement, and more loose with clayey slightly calcareous cement are met. Usually cement is filling the space between the predominant in the rocks fragmental material. But sometimes the cement is basal one and more rare pebbles of limestones has been sunk in it.

Limestones are of brown-red colour, being clayey, lumpy and are met in singular thin interbeds.

At the right slope of the Rudi-Chal river, to the East from the village of Cher Chenar the outcrop of the forming an anticline (the basement has not been exposed) Shafaian deposits can be observed. They have been composed of brown, red-brickly sandy clays, regularly interstratificating with brownish-grey hetero-pebbly conglomerates. The clays form interbeds being in the thickness I-3 m.; conglomerates -0.7-I.7 m. Towards the upper part of the section interbeds of gonglomerates are rarely and rarely met and in the upper part of the series (the thickness of which being 400 m. they are absent at all, and in clays only small dissiminated pebbles of limestones are present. Total apparent thickness of the Shafaian deposits reaches here 770 m. By a clearly pronounced, slightly wavy boundary(of slight washout?) on the Shafaian deposits occur the Koshtangin series of Miocene.

There have not been discovered any fossils in the considered above deposits. They are correlated by us with the Shafaian series of the Upper Oligocene-Lower Miocene. The series has been singled out by the Soviet geologists working for prospecting of oil in the northern part of the

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country, where Tertiary deposits have been distributed in general more completely, being represented by more thick series, and therefore, there are more foundations for their dissection (Bratash V.I. and otheres, 1961). The correlation is carried out quite confidently, as the North-eastern part of the investigated by us territory had been mapped in more small scale by oil-geologists as well, who had singled out the same formations which had been singled out by us, considering them to be as the deposits of the Shafaian series.

In favour of the Upper-Oligocene-Lower Miocene age of the Shafaian series speaks its situation in the section. The Shafaian deposits with a washout and probably with slight unconformity occur on the Turkestanian and more old formations up to Maastrikhtian ones. To the South from the village of Akhkotal the clays at the basement of the Shafaian series (with a washout occurring on Dat-Paleocene) contain pebbles of limestones in which the Suzakian form Gryphaea cf. camelus Burach, is met. From the other hand, towards the upper parts of the section the Shafaian series is concordantly replaced by Koshtangin one (Lower Miocene) and they are with unconformity overlained by Pliocene Rustakian conglomerates. Terrigeneous character of the deposits of the Shafaian series, taking into consideration the Oligocene age of the folding within the limits of Alpian geosyncline area and simultaneous orogeny in the adjacent extrageosynclinal areas, all this allows conditionally relate the accumulation of the Shafaian deposits to Upper Oligocen-Lower Miocene. The sedimentation took apparently place in separate intermontan and piedmont depressions in the conditions of water environment (lake, lake-river basins).

N E O G E N E S Y S T E M

Neogene formations are widely distributed within the limits of the investigated territory, involving the area of nearly 2000 sq.km. and forming the most vide fields in its northern part.

Neogene formations- excluding the Shafaian series of the upper Oligocene-Miocene, described above in the composition of the Paleogene system- have been divided into Koshtanginian and Madrian series of Miocene, and Rustakian - of Pliocene. Here the undissected deposits of Neogene and undissected deposits of Pliocene-Lower Quaternary division have been described also.

Miocene deposits (Koshtangin series) concordantly replacing the Shafaian series or with a washout and with unconformity (Madrian series) overlaying the Syzakian and more old deposits. In turn with a considerable unconformity on them as well as on the more old formations the Rusta-

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kian series is occurring. At last,with a washout on different underlying rocks occur undissected deposits of Pliocene-Lower division of Quaternary system.

Neogene deposits have been folded into large gently sloping folds, being usually brachiformous,jointed by fractures and complicating as moving towards the day surface of Paleosoic folded formations,especially in the North-eastern part of the investigated territory.

M i o c e n e

Miocene age is supposed by us already for the upper parts of the Shafaian series (see above). Completely to Miocene we relate the Madrianx and Koshtangin series. The former one is developed on a quite limited area in the South-western part of the investigated region,the latter generally in the North-East of it.

M a d r i a n s e r i e s

The Madrian series has been distributed on a limited territory in the basins of the Kamard,Saihan rivers and at their interstream area (fig.58).

At separate areas,in particular in the area of the Dashti-Safed,in the valley of the Sanjitak the deposits of Madrian series have been divided into three parts: the lower,the middle and the upper,having different lithological composition (fig.59).Of them the most wide distribution have the lower and the middle parts;the upper part almost everywhere had been eroded. It was established only at one point,at the up-streams of the Sanjitak sai. Besides it on a con siderable area of the interstream area of the Kamard and Saihan rivers as well as at the right bank of the Saihan river the undissected deposits of the Madrian series have been developed.

The lower part of the Madrian series is well exposed at the middle-course of the Sanjitak sai(fig.60). Here on the sandstones of the Suzakian stage with the washout occurs the bench of red-coloured rocks,being composed of ir regular interbedding of sandy red-brown clays,inequigranualr red sandstones and grey-brown fine-,and medium-pebbly loose conglomerates. The latter at the lower part of the section sometimes being coarse-pebbly and contain small and medium-sized boulders. Well and medium rounded pebbles are composed of the local rocks: limestones,sandstones,effusive rocks,etc. Noteworthy is the fact of the presence of vesicular and amygdaloidal lavas in a number of sections of the Sanjitak. They occur either at the basement of the section in the form of an

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independent bed, being in the thickness up to 3-4 m., or several meters above - on the bed of conglomerates and then they contain pebbles from the underlying conglomerates and as if "cementing" these conglomerates at their upper parts.

The presence of amygdaloidal lavas testifies to the slight manifestation of volcanic activity at the beginning of Miocene time.*)

In the adjacent regions the section of the lower part of the Madrian series keeps the same character. Volcanogeneous formations, however, have not been marked at another places. Total thickness of the lower part of the series amounts 40-55 m.

Middle part of the Madrian series in various regions has different lithological composition. In the sai of Sanjitak it has been represented below(about 20 m.) by interstratification of lumpy red and green clays, limestones being dense aphanitic of yellowish-grey colour, white loose marls and rarely by fine-pebbly, sometimes gravelly calcareous conglomerates. Interbeds have the thickness from 0.5-0.8 up to 2.0 m. Above, reaching the thickness of about I7 m. occur limestones of a lake type, being porous, with concretional composition, marls being dense light-grey and thin interbeds of calcareous aleurolites and grey clays. In this part of the section the concretional limestones are of interest. They have been composed of lolongated(acorn-like) or finger-like concretions with shelly or radiatefibrous fabric, being apparently formed at the fragments of stalks of plants, the traces of which could be everywhere seen in the forms of interstices and imprints inside these formations. Such concretions either not densely with interstices and pores being united with the help of calcareous cement, which also has a radialfibrous fabric, or being cemented densely, forming beds of massive composition. The upper parts of the section(about 38 m.) have been composed of massive thick bedded limestones, being of white or light-grey with interbeds of loose clayey limestones and with rare interbeds of limestones being of concretional structure. Loose marls contain numerous monotonous fauna of thin-valved Spirialis sp. Ostracoda, oogonys of chara algae and indeterminable vegetative remains.

Total thickness of the middle part of the Madarian series in the Sai of Sanjitak amounts 75 m.

Somewhat another section of the middle part of the Madarian sries is observed in the Madr valley (fig.60). In the lower parts of the section greenish-grey, thin-bedded clays (about 30 m.) have been developed, with rare interbeds of green foliated marly clays with the thickness of up to I0 cm. In the middle part - there is frequent interbedding of

*) The age of the described rocks is not yet confirmed by finds of fossils. It is possible that the lower parts of the Madrian series contain elements of Oligocene.

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light-brown (about 30 m.) and green-grey clays with interbeds (up to 0.30 m.) of fine-grained sandstones. The mentioned clays are calcareous and contain numerous shells of Spirialis sp.,being of the same appearence as in the sai of Sanjitak. At the upper part of the section thin interbedding of light-brown and green marly clays (about 60 m.) with interbeds of light-greyish fine-grained sandstones with the thickness being from 0.I up to I.0 m. In some benches sandstones are the predominant.

Total thickness of the middle part of the Madrian series in the sai of Madr amounts I20 m.

The replacement of calcareous section being observed in the sai of Sanjitak by the sandy-clayey in the sai of Madr and simultaneously with this the encreasing of its thickness speaks apparently about the accumulation of the deposits in the more near-shore part of the basin. The calcareous section apparently corresponds to more opened central parts of the basin.

Upper part of the Madrian series was observed at one point only- in the sai of Sanjitak. Here on limestones of the middle part of the section concordantly occur grey-green clays with interbeds of aleurolites and marly clays of the same colour. Rare interbeds of fine-grained conglomerates with clayey-calcareous cement are marked.

The apparent thickness amounts 60 - 70 m.

Total maximal apparent thickness of the Madrian series amounts I65 meters.

Madrian series,undissected occupies a vast space at the interstream area of the Kamard-Saihan rivers,as well as at the left slope of the Saihan valley at its up-stream part. For the lack of quite complete exposureness it is not possible to everywhere single out here the described above parts of the Madrian series. The parts of the section,related to the lower and to the middle parts of the Madrian series here have been determined clearly at a number of places,but they are not traced along the strike. The upper part of the series here was not marked. It has apparently been eroded. It should be noted that limestones with concretional structure,being characteristic for the middle part of the section,here are often marked,but they are alternating with sandy-clayey and sandy-pebbly benches, which have more great distribution here,as compare with the described section of the Sanjitak sai (fig. 60).

The apparent thickness of the undissected Madrian series amounts not less than 200 m.

The deposits of the Madrian series have continental origin. The red-coloured lower part is apparently the product of deposition of alluvial-proluvial streams and had been accumulated in the conditions of hot cli-

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mate. The middle part is typically lacustrine one. Small gastropodae and oogony of char algae, concretional character of limestones, all this testifies to the accumulation of the sediments in a fresh-water, apparently shallow basin, in the marginal parts of which terrigeneous deposits had been accumulated, and in the central ones - calcareous sediments. The upper part of the series apparently corresponds the final stage of filling and drying out of the basin, to what testifies the replacement of limestones by clays, sandstones and conglomerates.

The describing deposits in the region of the Doabi-Mekhzarin village and of the Madr village too had been investigated by G.N.Khatiskatsi (1963) who the lower 23 m. of sandy clays, sandstones and conglomerates conditionally related to the Talikanian series. According to his own observations, this basal bench with unconformity and with conglomerates is overlained by the Shafaian series of the upper Oligocene-Miocene.

The described by us sections are related to the continous cycle of sedimentation and do not contain any horizons, which could testify to a break of continuty and what is more to angular unconformity. The deposit of the Madrian series with unconformity occur on different by age rocks from the Dat-Paleocene limestones up to Suzakian deposits includingly. The correlation of these deposits with the deposits of the Shafaian series of the more northern regions is made by G.N.Khatiskatsi (1963) without any paleontalogical substantiations and has extreamely conditional character. There are no any determined data at our disposal too on the age of this series. We conditionaly consider the age of the Madrian series to be Miocene one.

Koshtanginian series

The Koshtanginian deposits have been distributed exclusively in the North-eastern part of the territory. They are gradually traced in the narrowing to the South strip from the Northern boundary of the investigated territory up to the region located to the North from the coaly deposit of Karkar. Often on a vast areas the Koshtangin series is being overlained by the deposits of the Rustakian or Quaternary age. The series is composed of clays, aleurolites, sandstones and conglomerates.

Clays are coloured in different colours. Most often they are brownish-fallow, red-brown, rarely grey, dark-grey, brownish-grey. They are dense rocks, usually being aleuritic, aleurolitic, or sandy. Sometimes they are calcareous, micaceous, being of lumpy, shelly or platy structure.

Aleurolites are of greenish-or brownish-grey colour. They are usually represented by fine-grained, calcareous, micaceous varieties. They are seldom met.

Sandstones are coloured in light brownish-grey or greenish-grey

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colour. They have been represented by medium-,and irregularly-granular varieties,sometimes by puddingneous ones. In composition they are polymictic,micaceous,slightly cemented by ferriferous-clayey or calcareous-clayey cement.

Conglomerates are light-grey or light brownish-grey being represented by fine-,and coarse and hetero-pebbly varieties,rarely by rubbly ones In well rounded and medium-sorted pebbles limestones are met (predominantly in the lower horizons of the section),effusive rocks,granites. Cement is gravelly-sandy-clayey,sometimes calcareous. In the section conglomerates are the predominant,usually they contain interbeds of red-brown clays.

The most complete section of the Koshtanginian series can be observed by the right bank of Rudi-Chal river,to the North-East from the village of Cher Chenar. Here the red-coloured series of the Shafaian series concordantly (only at some places a slight washout could be marked) is replaced by grey-coloured conglomerates,represented by interbedding of their varieties. The thickness of interbeds and benches of conglomerates is definetely predominant in the section,reaching I0-50 m. At the basement of the section sometimes a bench of thin interbedding of grey,greenish-grey aleurolites and dark-grey clays with subordinate interbeds of sandstones and conglomerates. The thickness of this bench reaches 50 m. Above the section almost completely is composed of the mentioned conglomerates. However,among them sometimes benches with the thickness of up to 30-50 m. of grey and greenish-grey sandstones,being loose,calcareous, containing interbeds and lenses of gravelly-pebbly material or interbeds of green-grey clays being thin-bedded and slightly calcareous are met. The benches of approximately the same thickness are met,composed of brownish-grey or brownish-fallow clay. Analogical or reddish-brown clays are met among conglomerates and in the form of interbeds with the thickness up to 0.5,rarely up to 5.0 m.

With a washout and with angular unconformity (up to I4°) the described formations are overlained by the Rustakian formations. Total thickness of the Koshtanginian series in the adduced section exceeds I500 m.

Analogical composition the Koshtanginian series has in the southern part of the field of its distribution,for instance to the East from the village of Baglan. The series which from beyond distance has red-brown or brownish-grey colour(in contrast to brickly-red tints being characteristic for the undrlying Shafaian series) has been composed of the same interstratificating clays,aleurolites,sandstones and conglomerates, with evident predominance of the latter in the section. The thickness of the Koshtanginian series (it has been also with a washout and unconformity overlained by the Rustanian one) here does not exceed 400-200 m.

The described deposits usually occur gently sloping,with the angles

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of dipping at the wings of large brachiformed folds up to I0-I5°. Howeve near the dislocations with a break of continuty,for example at the right bank of the Rudi-Chal river their steep,vertival or even overturned occurence can be met.

The accumulation of the Koshtanginian deposits,as well as the Shafanian ones had been continuing within the limits of vast lacustrine(?)-alluvial plains,under the activity of continental denudation of the terri tory and abundant coming of fragmental material.

In the described above deposits we did not discover any fossils.*) They have been singled out by us as an independent series (in conformit with the suggested before stratigraphy of Tertiary deposits,Bratash V.I. and others,I964) somewhat conditionally. The Koshtanganian series is singled out as the upper,materially fragmental (in contrast to the lower part being materially clayey- Shafianian series) series,being as a constituent part of the united clayey-fragmental red-coloured series. The two series besides the difference in their lithological composition are well distinctive for their colour: brickly-red and reddish-brown - the upper one.

The age of the Koshtanginian series is conditionally considered to be Miocene,on the grounds of its situation in the section,as well as on the grounds of its correlation with the Khingouian sseries of Tajikian depression,for which Miocene age had been established (Ja.R.Melamed,I964

P l i o c e n e

The Pliocene deposits being widely distributed in the North-Eastern Afghanistan are divided into a number of series within the limits of the investigated territory being represented by the Rustakian series only. However,they occupy here considerably more large area as compare with the other subdivisions of Neogene,composing large fields in the northern part of the region. In this section of the report the undissected deposits of Pliocene-lower division of Quaternary system have been described,being met in far South-West of the investigated territory only.

R u s t a k i a n s e r i e s

The Rustakian deposits have been developed almost everywhere,but th most large areas have been occupied by them in the North-West and especia ly in the North-East of the investigated territory.

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*) The indications on the presence of thick interbeds of limestones with oysrea anomg the Koshtanginian deposits to the South from the town of Talukan is a misunderstanding. The carried out by us works have shown that the mentioned limestones contain Maastrikhtian fossils and are protruding in the field of Koshtanginian deposits development in some tecton

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They fill large depressions of the relief and have a gentle monoclinal occurrence, or especially in the North-East they form more or less large brachiformed folds. The Rustakian series has been composed exclusively of clays, aleurolites, sandstones and conglomerates.

Clays have brownish-fallow, light brownish-grey, rarely greenish-brown or brickly-red colour. They are dry lumpy rocks, being sandy or aleuritic They usually compose thin (I-2 m.) interbeds.

Aleurolites are of grey or greenish-grey colour, they have a polymictic composition, micaceous, sometimes contain considerable admixture of clayey and sandy material.

Sandstones are of light-grey or grey colour being represented by fine-, medium-, anf coarse-grained varieties. They all are polymictic; composed of grains of quartz, feldspar, flakes of biotite and muscovite. The rocks are medium-bedded (the beds from 0.2 - 0,4 m.), cross bedding is sometimes met. They have been medium or slightly cemented by calcareous-clayey cement, sometimes quite easily scattering into sand and they often contain lenses and interbeds of gravel and shingle. They form interbeds and benches with the thickness up to 30 m.

Conglomerates are of grey colour being represented by fine-, medium-, and coarse-pebbly varieties. In well rounded and medium-sorted pebbles porphyrites and other effusive rocks and their tuffs, crystalline schist granites, sandstones, limestones are met. Cement is calcareous-clayey or sandy-calcareous-clayey. Conglomerates compose the main part of the section, forming benches with the thickness up to I0-50 m. and in turn contains interbeds and lenses of sandstone up to 2-3 m.

The most complete section of the Rustakina deposits is observed in the North-East of the region, at the interstream area of the Rudi-Shorau-Chal (Bangi) rivers. The Rustakian formations are folded in gentle isometric folds, often, especially at the interstream areas, they are overlained by eolian-detrital deposits of the Upper Quaternary division, and at last they are characterized by fast facial alterations. That is why it is difficult to speak on the leaf-by-leaf section of the Rustakian series and one can adduce its general characteristic only. The Rustakian deposits are occurring here with a sharp washout and with angular unconformity on the Koshtanginian ones. For example, by the two banks of the Bangi river (fig.6I) to the South-East from the village of Cher Chenar the conglomerates of the Rustakian series are superimposed on the grey-coloured conglomerate series of the Koshtanginian series with an angular unconformity up to I4°. From the underlying conglomerates they are distinctive only by the presence of interbeds of clays of pale-brownish-grey colour, in contrast to the interbeds of red-brown clays among the Koshtanginian conglomerates. The thickness of this basal conglomerate bench of the Rustakian series exceeds I00 m. However, in the adjacent regions by the right bank of the Bangi river at the basement of the Rustakian series the bench with the thickness up to 50 m. is marked, being composed of light-brown clays, also occurring with a washout on the Kon-

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Koshtanginian deposits and only above being replaced by interstratification of more coarse-fragmental deposits. Analogical interbedding of sandstones, conglomerates and clays can be observed above by the whole section. They compose separated benches with the thickness up to 10-50 m., however in every one of them thin interbeds of distinctive rocks can be met. For example, the interbeds of sandstones in the bench of conglomerates, interbeds of conglomerates in the bench of clays, etc. Total thickness of the Rustakian deposits in the considered region is approximately valuated to be 2000-2500 m.

To the South from the considered area the Rustakian deposits with a washout and angular unconformity occur on more old formations. For example, in the region of the town of Puli-Khumri on the Allaian-Turkestanian Suzakian or Dat-Paleocene formations, in the western part of the region - on the Jurassic and more old ones, up to the lower Paleozoic. However, the character of the deposits of the Rustakian series, traced almost by continuous strip from the interfluve area of the Rudi-Shurau-Bangi up to the town of Puli-Khumri and further to the West up to the North western part of the investigated area, (to the North from the coaly deposit of the Dokhani-Tor) remains the same. Everywhere it is a clayey-fragmental series of brownish-grey colour, characterized by fast facial alterations and by replacement of one fragmental rock by another. The observed at some places difference in the composition of pebbles of conglomerates is explained exclusively by the composition of the rocks lying in the local areas of washout and removal during the Rustakian epoch. In the direction from the East to the West gradual decreasing of the thickness of the Rustakian deposits takes place, which does not exceed in the North-West of the region 1000-1500 m.

The Rustakian deposits are characterized by gentle, often trough-like occurrence, plunging to the center of the filling by them depressions at the angles of 5-20°. From the West to the East the encreasing of the degree of dislocation is seen. In the North-East they are folded in numerous folds, dome-like and trough-like, having near the dislocations steep or even vertical occurrence.

The accumulation of the Rustakian deposits, after apparently short interval of time at the boundary of Miocene and Pliocene, had been continuing with the previous intensity. The clayey-fragmental formations filled vast lowered areas of the territory, including the most extent ones, being probably continuing their downwarping in the North-East of the region. The sedimentation had apparently taken place in the conditions of water environment, within the limits of fluvio-lacustrine basins.

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In the Rustakian deposits we did not discover any fossils. However, in the samples for spore-pollen analisis from the lower part of the section of the Rustakian series in the region of the Puli-Khumri town (Khatiskatsi G.N. and others,I963; Bratash V.I. and others,I964) sporae and pollen of grassy and bushy plants and thermophillic plants' grains were discovered. They are Osmunda aff. cinnamoea L.,Tilia cordata Mill., Artemisia sp, Inglans aff. regial.,Taxoiaceae gen. sp, Ulmaceae gen sp., Chenopodiaceae sp. and many others,allowing to date the age of the enclosing deposits as to be Pliocene one. Respectively the Rustakian series is related by us to Pliocene.

N e o g e n e d e p o s i t s u n d i s s e c t e d

Small by area outcrops of Neogene,closely undetermined deposits were observed in the North-East of the investigated territory. Here due to considerable turfness of vast areas it is sometimes difficult to say to which part of the Neogene section this or that deposits shuld be related. Usually neither lithological character nor the mode of occurrence can provide the foundations for more accurate their dating. In outward appearnce these deposits are near to the Koshtanginian as well as to the Rustakian formations,described above,but they sharply differ from the Shafaian ones.

P l i o c e n e - L o w e r Q u a t e r n a r y d e p o s i t s

The deposits of the Pliocene-Lower Quaternary age have been singled out by us on a limited area in the basin of the Saihan river. At the basement they have been represented by coarse pebbly-rubbly conglomerates,being composed of medium-rounded fragements of the local rocks (from X6 up to 30 m.) (the Dat-Paleocene limestones,metamorphic rocks,quartz, etc.),being densely cemented by sandy-gravelly-calcareous mx cement. In the relief these conglomerates usually form cliffs.

At the upper part of the section (the apparent thickness being from 60 up to 90 m.) these deposits have been composed of the same as at the basement conglomerates,but the fragmental material in them is somewhat more well rounded,with less admixture of boulders,the cement is loose. Among the conglomerates lenses of sandy composition are often met. Bedding is hardly noticeble. The rocks have characteristic yellow-brown or grey-brown colour.

Total apparent thickness of the Pliocene-Lower Quaternary deposits reaches 90-I00 m. They occur on the rocks of different age - from the

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Jurassic up to Lower Paleozoic ones - with sharp angular unconformity. Their stratum is very slightly dislocated: angles of dip reach 5-8°, only in the zones of fractures the near-fractured folds can be observed.

The describing deposits occur in the ancient valley of Saihan, being situated at the altitudes from 270-up to 500 m. above the recent watercourse of the Saihan river. On them the plained surface, gently inclined from the mountains to the watercourse of the river is worked out. The adjacent mountains are elevating above this surface for 300-350 m.

In the origin the rocks are most of all alluvial-proluvial ones. Their Pliocene-Lower-Quaternary age is supposed by us on the grounds of the adduced above geologo-geomorphological data only.

Q U A T E R N A R Y S Y S T E M

On the territory being of our interest the deposits of Quaternary system have been represented exclusively by the formations of continental origin and being very irregular both in the thickness and in distribution. Their accumulation and denudation are closely connected with geomorphological peculiarities of the region. Foe example in the limits of the intermontane regions having a steep-sloped erosional relief they form predominantly narrow strips, filling the bottoms of valleys and the adjacent to them lower parts of the slopes and extreamely rarely marked on the slopes and tops of mountains.

In the region of structural-denerdational relief development, where erosional processes are more slightly pronounced, the areas of the Quaternary deposits distribution are more wide; at some areas they are by a continuous cover clothing slopes and tops of the hills, composing vast spaces

Quaternary deposits have the most wide distribution in the North-Eastern part of the investigated territory, at its North-western low-mountain part. Here their cover occupies, especially in young depressions an area up to I000 and more sq.km.

The thickness of Quaternary deposits is ranging in very wide limits, changing from parts and first meters up to several dozens of meters. In depressions it reaches apparently I00 and more meters.

Quaternary deposits by the geologo-geomorphological features have been dissected by us into the following divisions: Lower, middle, undissected middle and upper, upper, undissected upper and recent and recent. Besides it, each of the mentioned above divisions unites genetic types of deposits. Among the latter the following have been singled out by us: alluvial, alluvial-proluvial, alluvial-lacustrine, proluvial, eolian-talus,

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talus, colluvial and glacier ones.

The most wide aerial distribution have the deposits of the upper division and undissected deposits of upper-recent divisions with characteristic for them eolian-talus, alluvial and alluvial-proluvial deposits.

Lower division

The deposits of the lower division had been established in the region of the Puli-Khumri town, where they compose the most high alluvial terrace of the Surkhab river. Here on the left slope of the valley, at the altitude of 230-250 m. above the water-course of the river (at the absolute mark of 700 m.) an unclearly pronounced in the relief cliff, deeply cuted in by the valley is seen.

The describing deposits here have been represented by pebbly-rubly conglomerates (the size of pebbles 10-15 cm.) being composed for 85% of igneous, for 12% of metamorphic and for 3% of calcareous rocks. Cement is loose sandy. Lenses and interbeds of sandstone are often met. The bedding is unclear. The described rocks have an apparent thickness of not less than 60 m. They are apparently belong to the ancient alluvium of the Surkhab river, however their extreamely limited distribution does not allow to make any definite conclusions on this problem.

In another more uplifted regions of the investigated territory there Lower Quaternary deposits were not established. However, at the level of 250-280 m. above the level of rivers, for example in the region of the Doabi-Shakhpasand villages a clear bend in the slope of the valley in a form of small branch is marked, on which dissiminated pebbles (up to 10 cm. in diameter) of exotic rocks-granitoids, effusives, etc. can be seen, (absolute mark is 2000 m.). Plained structural surface of Neogene age here is situated approximately 250-350 m. above this branch. It is possible that the formation of this level as well as the deposition on it of pebbly material is related to the Lower Quaternary epoch. Analogical levels, situated approximately at the same relative altitude can be observed at another places too, for example in Larkhob (fig.62), Saihan etc. Usually on them the covers of more young loeses and loes-like loams, covering the deposits of Early Quaternary age are marked.

Middle division

The rocks of the middle division have in general also limited distribution, but they are more often met, as compare to the Lower Quaternary ones. They are represented by alluvial, alluvial-lacustrine, alluvial-proluvial and glacier deposits.

Alluvial deposits are mainly marked in the valleys of large rivers,

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such as Farkhar,Namakab,C hal,Surkhab,Doi-Tangi,Aokhorak,Alma,Chakhar-Dek,etc.

By these deposits alluvial and accumulative terraces of the upper complex with the height of from 60 up to I30-I40 m. in the quantity of two or three,are being composed. Usually they are not clearly pronounced in the form of separated fragments,traced along the slopes of the valleys. Of them a low terrace (60 m.) is often preserved,as for example it has the place in the valley of Surkhab,near the village of Doshi. More rarely - the upper (I20m.) one,for example at the left slope of the Surkhab river.

The deposits composing these terraces are very monotonous and are represented by shingles. The size of pebbles ranges from 2-3 up to I0 cm Sometimes,for example near the village of Doshi in them a number of small and meduim-sized boulders is marked. Fragmental material is composed of granitoides,metamorphic schists and other paleozoic rocks; limestones are rarely met. Slight cementation of shingle by clayey-sandy-gravellite cement. Shingles contain lenses of sands,with an admixture of pebbles being with cross bedding,with sandy clays(rarely). The upper part of the section is usually more fine-fragmental. The thickness of the deposits is apparently more than 60 m.

Alluvial-lacustrine deposits have a limited development and have an insignificant areas of distribution,occupying parts of sq.km. They are known for example in the valley of Kamard river,on the area of the Dashti-Safed,in the left tributaries of the Kamard river: Sukhshar,Sukidarra Ferozak,etc.,in the left tributary of the Larkhob river,at the confluence of the rivers of Lela and Chakhar-Dekh,as well as at a number of ot others places.

Mostly they have been represented by light-pale of different tints (from brownish up to unclearly-pink) fine-grained sandy loams,being of ribbon structure. The rock has been composed of thin grains (0.05-0.0I mm.) of quartz,less of feldspar and flakes of mica with clayey-calcareous or calcareous very weak cement. The strips now more dark, now more light (the first ones being inthe thickness I-3 mm.), the second -4-5 mm.),such thin interbedding periodically in 4-6 cm. is changed by interbeds up to I0-25 mm. of fine -grained,slightly semented dark-brown fine-grained aleurolite. The interstratification has rhythmical character. At the basemebt of such section interbeds of more coarse-grained rocks are observed: sandstones with fine pebbles,gravellites and fine-pebbly conglomerates with coarse cross bedding. The thickness of the lacustrine deposits reaches I00 m.,and is apparently dependeble on the amplitude of replacements by tectonic fractures,which

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provide an uplifting of the river and formation of lakes. For example, in the left tributary of the Surkhab river the amplitude of dislocation by the tectonic fracture, which provided the uplifting of the river and formation of small lake is considered to be I00 m.

Alluvial-proluvial deposits have a limited distribution and were marked by the left bank of the Surkhkala river valley, as well as at another places. They are lithologically differ from the alluvial deposits of the same age only by more slight roundness of the material, by the presence of being sometimes semi-rounded fragments of local rocks, These deposits compose the same high terrace-like levels as the same by age alluvial formations.

x Glacier deposits are known in the East of the investigated terrritory, mainly in the upper parts of the Chakhar-Dekh, Sary-Tor, Chenarak, Alma, Aokhorak, etc. rivers. They have been represented by moraines, mainly being bottom and less of side type. The areas occupied by them reach here I2 sq.km. filling the valleys of trough-like form (up-streams of the Alma river). Absolute altitude of their distribution is usually kept in the interval of 3000 - 3200 m.

Glacier deposits have no good sections. Only at some places it is possible to determine their clayey-wasterock-rubbly character of composition. Their surface is usually strongly turfed and has a typical small-mosaic relief with large boulders and rarely with lumps or blocks at the surface. At the steep areas on these deposits the salt-fluctional terrace like cliffs, rarely landsliped small terraces. Often the moraine deposits are strongly alterated by proluvial processes. Prolluvium is recent one, and the more old is apparently comes into the former or most often it overlines them, filling the sinks of the relief (the region of the Kotali-Sabzak). In this case we singled out a mixed genetic type "the glacial-proluvial one" These deposits have a very limited distribution.

U p p e r d i v i s i o n

The deposits of upper division of Quaternary system, as it was pointed out above, have in the investigated region the most wide aerial distribution. Among them the following are singled out: glacial, eolian-talus, alluvial-lacustrine, alluvial, alluvial-proluvial, proluvial formations.

Alluvial deposits involve a complex of middle alluvial terraces, being represented by two, three (rarely), by cliffs with the height of I2-I8 25-35 and 38-42 m. above the water-course. In some valleys their height id noticebly decreasedas coming closer to the up-streams of rivers. The upper terrace level is comparetively rarely observed and is not clearly pronounced. The mentioned terraces have a clearly pronounced socle

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character,what allows to establish a complete thickness of the alluvium. Usually it amounts 7-8 m. in the lower terrace and I2-I5 m. in the middle one.

Terraces of the middle complex,especially the lower one,have quite wide distribution in the valleys of the Farkhar,Namakab,Chal,Nakhrin, Surkhab,Saihan,Doab,Darra-i-Suf and others rivers;they are traced along the valleys often with considerable intervals,being on large areas completely destroyed by the latest erosional processes. Alluvium of these t terraces has quite monotonous structure. The lower part of the section being in the thickness from 5-6 up to I0-I2 m. is represented by shingles with an admixture of boulders,middle and rarely large in size. The filli is slightly clayey,sandy-gravellite,usually loose. Among the shingles lenses with the thickness from first dozens of cm. up to I-I.5 m. are often met,being composed of loose clayey sandstones with gravell and pebbles,often with coarse cross bedding and rarely by brown sandy clays. Above a bed being from 0.5 rarely up to I.0 m. in the thickness composed of loose sandstones with lenses of gravel and with singular pebbles,grading into sands being clayey of brownish-grey colour,with lenses of clays with the thickness of the latter being up to I-I.5 m. is usually met. The most upper parts of the section have been composed of yellow-brown covers of loams,the thickness of which being up to I-I.5 m.

Alluvial-proluvial deposits have an extreamely small area of distribution. To them we relate the areas on which these deposits in the scale of the map can not be seen. To them we mainly relate the deposits of alluvial terraces and of proluvial cones.

Alluvial-lacustrine deposits are known in the Puli-Khumrian depression (sometimes - furrows of the same name). They compose a plain,completely developed for agricultural lands. The recent water-course has been cut in this plain for I2-I6 m.

At the bort of the channel near the northern electric power station the section of these deposits can be seen. At its basement grey of swampy type sandy,at some places ferruginized (by spots) clays with rare linses of fine sand and gravell with the apparent thickness up to I0 m. can be seen. The upper part of the section is composed of more sandy grey-brown clays,being also with interbeds of fine grey sand and rarely of gravel. Thin horizontal bedding can be observed.

Proluvial formations also have very limited distribution,mainly observed at the confluences of rivers of medium and large scale (for instance the rivers of Surkhab and Farkhar) with their comparatively large tributaries. Proluvium is represented by medium-rounded shingles,some-

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times with boulders and even with blocky material with loamy-sandy-gravelly filling. These deposits form high fans united with terraces of the middle complex. They have been cut in by the recent water-channels for the depth from I0-I2 up to 25-28 m.(for example in the mouth of the Nalak Istoma and others rivers - the left tributaries of the Surkhab river)

Eolian-talus deposits have the most wide distribution in the North-East and in the central parts of the investigated territory,where they continuously cover the areas of dozens and hundreds of sq.km. In the form of separate spots being in the area of up to I0 sq.km. they were also met in the North-West of the region. Eolian-talus deposits are usually represented by loes-like loams and rarely by typical loess.

The loess-like loams are of pale,sometimes of brownish-pale colour, micaceous,porous with columnar jointing. They are of massive unclear - bedded structure. They often contain lens-like interbeds of aleurolite, or of fine-grained sand,rarely of gravell or even of fine-wasterock material (the size of fragments being from parts up to 4-5 cm.). Rare calcareous concretions,fragments of thin-valve shells of land gastropodas traces of root parts of plants,humik spots and rarely horizons of burried soils. Separate horizons are composed of loess rocks.

Loess are more rarely met. In the colour and in granulometric composition as well as by structure-textural features correspond to typical loess,which widely distributed in different region of Asia.

Loess-like loams and loess occur on different by age rocks from Pre Cambrian up to Pliocene (Rustakian series),and also on the Middle-Quaternary deposits (on terrace levels of middle and upper complexes). The thickness of loess-like loams and loess reaches 50 m. (northern bort of the Puli-Khumrian depression). It is probable that the primary thickness of loess was more great as at the present time loess-like loams and loess are everywhere eroding.

The formation of loess-like loams and loess is related by us to the first part of the upper Quaternary epoch (Riss-Vurmian middle-pluvial). According to our viewpoint these loess had been accumulating as eolian formations. To this assumption besides the well-known facts testifies their occurrence in the form of covers the thickness of which being up to I0-I5 m. on middle and upper parts of steep(up to 20°) often rocky deep valleys,being for example composed of coarse-terrigeneous upper Jurassic deposits or volcanogeneous upper Triassic formations,or at last of metamorphosed schists of middle Paleozoic age. Such occurrence was for example observed at the upper-stream of the Sanglyashm river (upstreams of the Zamburak river) at the Kishaktone or at the left tributa-

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ries of the Farkhar river as well as at another places. The fact that some cliffs and protruding parts of the bedrocks as if "piercing through" the loess cover, is very interesting and this phenomenon can be explained either by not complete burial of them under the loess,or by their partial preparation. The mentioned with an evidence confirm the fact that the formation of loess took place after the steep-sloped relief was already formed.

The loess-like loams were apparently formed by mixed way,for all this the eolian loess were periodically alterating at slopes by deluvial processes,which provided them with coarse-terrigeneous material. This process in the region under consideration was widely developed,due to which the loess-like loams and loess themselves are practically non-divided and very likely they are the first ones which have more wide distribution as compare with the second.

Glacial deposits of this age have an extreamely limited distribution They compose small isometric areas with the areas of not more than a quater of sq.km. in small cirques at the southern slope of the Baba mountain,at the up-streams of the Sargala and Akhmanaran rivers at the easter slope of the Kukhi-Kargazi mountain,in the basin of the Chakhar-Dekh river and at some other places.

Glacial deposits in circuses are usually represented by bottom moraines,being slightly destroyed,slightly turfed,with typical morainic relief. The moraines are mainly composed of unrounded at all or of slightly rounded local material. Their thickness does not exceed IO m.,but usually it is less.

For morains of this age an absolute altitude of the distribution, being within the interval of 3500-3880 m. is characteristic.

Upper and Recent divisions undissected

To the undissected deposits of the upper and recent divisions we mainly relate the alluvial-lacustrine deposits,proluvial formations of fans,talus-proluvial deposits developed at the foots of gentle slopes, as well as talus trains. In all these genetic types the deposits both of upper Quaternary and Recent ages are closely interwoven. In fans the latter usually have the character of complicatedly branching watercoursed accumulations or of continuous " fractures" overlaying on considerable areas,but being non-mapped in the scale of the maps,the Upper Quaternary deposits.

Alluvial-lacustrine deposits are observed in the Ishkamyshian depression. They are extreamely poorly exposed. Only at the marginal parts,

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in rare scours, grey fine-grained micaceous sands and grey clayey (of swampy type) sandy clays with traces of root sytems of plants. Their apparent thickness amounts only I-I6 m. These deposits are possibly of upper Quaternary age. At the very this place, especially in the central parts the recent alluvial and in less quantity alluvial-swampy deposits have been accumulating.

Proluvial deposits of quite vast fans are widely developed at the marginal parts of young depressions (Puli-Khumrian, Ishkamyshian, etc.), as well as in the valleys of large rivers, such as Farkhar, Surkhab, etc., with large side tributaries. The area of separate fans reaches 80 sq.km. the area of jointed ones - up to 200 and more sq.km.

Proluvium is composed of differently rounded pebbly-rubbly fragments and rarely of blocks, composed of local rocks, slightly cemented by sandy-loamy material. The surface of fans of this age is usually turfed, less at the head and more in the marginal parts. Recent waterflows by one watercourse or complicatedly interwoving sharply cutting the proluvium for the depth from parts of a meter at the marginal parts up to I0-I2 m. at the head part of fans. Rarely and only in the valleys of large rivers such as Surkhab and Farkhar one can observe as proluvium occurs on alluvial terraces which have a height of I0-I2 m. above the watercourse of a river, and partly uniting with these terraces(for example at the mouth of the Piez-Kul river - right tributary of the Surkhab river).

Loess-like loams and loess do not cover the surface of fans of this age. It is most probable, that the proluvial deposits are somewhat younger than loess and are cut into them.

The formation of proluvium of this age is mainly connected by us with the second part of upper Quaternary and probably the beginning of Recent epoch, that is mainly with the period of pluvial, while the formation of loess and loess-like loams preceded this period.

Deluvial-proluvial deposits have in general a limited distribution. They were observed in the region of Ishkamyshian depression, where they compose considerable area at the basement of gentle north-western slopes of the depression, as well as in gentle valleys.

These deposits are mainly represented by yellow-brown loams with interbeds of sands, shingles and rarely of fine wasterock, forming small trains. The latter sometimes changed by small plained fans, composed of sands and sandy loams of proluvial genesis. Near the slopes yellow-brown talus loams are the predominant. The thickness of these deposits is sharply ranging, but it does not apparently exceed I0-I5 m.

Talus deposits are represented by yellow-brown up to pale loams, and in this or that degree contaning unrounded fragments of the local

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rocks. These deposits overlain by trains the gentle slopes and being cut in by the recent waterflows. From the eolian-talus deposits they differ by considerable saturation of coarse-fragmental material and more considerable alteration by recent deluvial processes.

Recent division

The deposits of the recent division have little distribution. They are represented mainly by alluvial,alluvial-proluvial and proluvial deposits; colluvial-proluvial,colluvial,talus, talus-proluvial and lacustrine deposits are more rarely met.

Alluvial deposits compose the lower complex of accumulative terraces with the height of the latter being 4 and 6-8 m. above the water-courses (fig.63,64). These deposits usually have monotonous sections of the following structure(the valley of Madr river,terrace with the height of 8 m. from the bottom):

I. Clay brown-fallow sandy with rusty spots,at the upper parts is bedded with interbeds of gravell and pebbles and with roots of plants. Lenses of swampy clays and traces of fossil soil are marked. The apparent thickness is ..... 2.0 m.

2. Loam sandy brown,at the basement there are lenses of calcareous tuff with the thickness up to I0 cm.,above there appear interbeds of shingle with the thickness from 3 up to 6 cm.,and from the middle part and towards the upper part - interbeds with boulders with the thickness 0.40 and rarely I.0 m. This bed at some places is completely replaced by shingles with boulders and lenses of brown clayey sand ....4.5-6.0 m.

3. Covering loam of brown colour with fine pebbles - 0.5 m. The bed "I" is often absent in the sections (or is not exposed),it is possible that it is related to more ancient buried terrace level,for example of upper Quaternary age.

Fluvial deposits are represented by shingle-rubbly,less by sandy and and clayey-sandy material. Their maximal thickness,in the most large rivers is hardly exceeds I0-I5 m.

Alluvial-proluvial deposits among the recent deposits are the most widely distributed. They are represented by wasterock-pebbly formations with an admixture of boulders,rarely - by sandy-pebbly and clayey-sandy-pebbly ones,filling the watercourses of shallow rivers and their numerous lateral " dryed" tributaries. In the composition these deppsits are less diferent from alluvial ones.

Proluvial deposits are everywhere distributed,composing recent fans and filling the watercourses of temporaly acting waterflows. Their material is represented by well-.medium-,and poor-rounded fragments of

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the local rocks with the size being from parts of cm. up to the first meters,it is as a rule slightly or is not at all sorted,loose with clayey sandy infilling. In cases of mudflow accumulations the material is more heterogeneous by the conseness and is not rounded at all. The thickness of proluvium ranges very greately, reaching the maximal apparently being 6 - 8 m.

Colluvial-proluvial deposits are singled out in narrow "dryed" valleys,as well as at rocky slopes,cuted in by small temporal waterflows. In these cases the conditions for mixing of these two genetic types of Quaternary deposits appear. In outward appearence these deposits alike the proluvial,but being enriched or partly overlained by colluvial coarse - fragmental accumulations.

Colluvial deposits have a quite wide distribution,forming at the basement of steep rocky slopes almost continuous strips and trains of hillside waste or dumpy accumulations. They have been represented by non-rounded at all rock-waste or blocky-wasterock material,often with very large blocks (dozens of cubic meters). Such accumulations compose areas being up to I.0 and at separate places up to 4 sq.km. (for example at the up-streams of the Pashagol river). At another places they completely partition off the valleys of comparetively large rivers,covering under themselves a water-flow at the extent of up to 0.5-I.0 km. (for example of the Chakhar Dekh and others rivers).

Talus deposits have almost everywhere distribution,for the exaption of areas with steep sloped erosional relief. They have been represented by yellow-brown sandy loam,in different degree saturated by waste-rock material. The thickness of talus ranges from parts up to 5,rarely up to I0 m.

Talus-proluvial deposits have been distributed at the areas with gentle relief,cuted by wide valleys of temporal waterflows,as for example in the North-East of the region at the areas adjacent from the North-West to the Ishkamyshian depression. These deposits here have been represented by sandy loams,oftem with fine-waste-rock material. They are forming at gentle slopes as a result of deluvial processes. However,in gentle and wide valleys these deposits are partly redeposited by numerous small proluvial waterstreams. The thickness of these deposits is apparently small and hardly exceeds I0 m.

Lacustrine deposits are rarely met. They are known partly in the Ishkamyshian depression,where a recent small lake is still existing,and in the West of the region at the up-streams of the Chakhar-Dekh river at the area of Igargu,where a lake with the area of nearly 2 sq.km.

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had been existing appoximately 20 years ago,and at the present time it is completely dryed out,apparently in connection with the formation of an underground drainage. The lacustrine deposits here had been exposed at the middle part of the area with the help of pit for the depth of up to 3 m. They have been represented by viscous grey silty clays with numerous remains of algae. Among the clays lenses of more sandy clays and rare small calcareous waste-rock are often met.

Chapter IV.

INTRUSIVE FORMATIONS

Intrusive rocks have been exposed on the area of the investigated territory being nearly 600 sq.km. Among them the rocks from the group of granitoides: granites,granodiorites,diorites and quartzy diorites are sharply predominant; hyperbasites(serpentenites),gabbro,diabases intrusive andesites,andesito-basalts,porphyrites,spessartites,etc. are also met. The formed by them intrusive massives or stocks and dikes are situated exclusively among the Paleozoic and Triassic formations(fig 65 being in this case met in the central part of the region under consideration only,as well as along its southern and eastern boundaries. The most large massives are met in the central part of the region under consideration. Usually they have elonglated form in accordance with the strike of country rocks in the north-eastern direction,representing by themselves large batholiths (for example the Saihanian,Surkhabian and Kalagaian),involving the areas of dozens and hundreds of sq.km. More often however, these intrusive formations compose more small massifs,dikes and stocks.

In the investigated region three different by age complexes of intrusive rocks have been singled out: Carboniferous,Upper Triassic-Lower Jurassic and Upper Jurassic. The first two complexes have been represented by large intrusives of granitoides,emplaced in connection with the Variscian and Early Alpian epochs of tectogenesis. Especially clearly pronounced the granitoidal magmatism of the Upper Triassic -Lower Jurassic time,corresponding to semi-platform stage of the considered area development. The Upper Jurassic complex has been represented by small intrusions of diabases,spilites and andesites. Their emplacemnet is most probably connected with the manifestation of tectonic movements during the Pre Lower Cretaceous time.

The describing below intrusive complexes are cutting through the different by age deposits,being however not younger than Callovian. The observed intrusive contacts with different stratigraphical subdivisions,

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as well as the occurrence of the latter with a washout on this or that intrusive formations, served as a basement for the dissection of the intrusive formations into age complexes. Besides it, the intrusive undissected rocks, the age of which can not be correctly determined have been singled out here.

In the adjacent regions the probability of the presence of Pre Paleozoic granitoides is not excluded. Their pebbles in abundance is met in the horizon of conglomerates, occurring among the deposits of the Syadarin series (lower Paleozoic) at the right bank area of the Saihan river.

C A R B O N I F E R O U S I N T R U S I V E C O M P L E X

Intrusive rocks of the Carboniferous intrusive comples have been distributed in the North-eastern part of the investigated area, forming several small massifs. The most young deposits, which are cutted trough by them , are related to the Durambakian series of the Sillurian and Devonian ages. 3 km. North-East of the Samandao village, as well as at the medium-course ofthe right tributary of the Rudi-Chal river they are transgessively overlained by the Upper Carboniferous- Lower Permian deposits

The intrusive comples under consideration has been represented by intrusions of diorites, granites and granitoides (fig.66). Diorites are cuted through by granites and granodiorites. The relationship of granites with granodiorites is not known.

Diorites

Among the intrusive rocks of the Carboniferous complex diorites have the most wide distribution. The area occupied by them amounts approximately 62 sq.km. At the headwaters of the Rudi-Mandarra, Bazarak and Rudi-Zamburak rivers(the right tributaries of the Rudi-Chal river) they compose the Pumbakian intrusive. To the West from the village of the Danan-Shira another one intrusive complex is sutuated named as Darra-i-Bekhian. At last, at the down-stream of the Shulesh-Darra river another one small intrusive, which apparently is the apical part of the Darra-i-Bekhian intrusive is situated.

The mentioned intrusives have been composed of monotonous in outward appearence dark-green, greenish-grey, dark-grey coarse-grained, rarely medium-grained rocks, which sometimes have slightly-pronounced porphyry fabric. With the help of microscopic investigations among them were established diorites, monzonites and quartzy monzonites. Of all these varieties the most widespread are diorites. Monzonites and quartzy monzonites

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apparently compose separate irregular by form areas and shlieren seggregations.

Diorites,monzonites and quartzy monzonites have quite alike mineralogical composition. They have been composed of plagioclase,hornblende, quartz,orthoclase,monoclinal pyroxene,magnetite,sphene,apatite. Colour index of the describing rocks ranges within the limits of 25-40. Diorites have hipidiomorphic-granular textures,monzonites and quartzy monzonites have typical monzonite texture. The predominant darkcoloured mineral in these rocks is pale-coloured hornblendl, which forms subidiomorphic,sometimes irregular grains. In monzonites idomorphism of hornblendl is better pronounced. Hornblende in diorites is often overgrouthed by biotite,and for all this sometimes contains un-replaced relics of monoclinal pyroxene. For monzonites and quartzy monzonites the presence of un-replaced grains of biotite and associated with it chlorite in hornblend is more characteristic. Plagioclase is zonal,composes large subidiomorphic (in monzonites idiomorphic) isometric grains and plates. The composition of plagioclase ranges within the limits of No.35 and 45. Internal zones of crystalls of plagioclase are usually intensively sericitizated and partly replaced by saussurite. Orthoclase in diorites forms small interstitial,rarely granular seggregations; in monzonites - large poikilitic xenomorphic grains,enclosing idiomorphic ingrowths of plagioclase,hornblende and pyroxene. Quartz is usually also interstitial,in quartzy monzonites its content reaches I0-I5%.

The apical parts of intercusions of diorites have been composed of schistose (trachitoidal) gabbros,coarse-grained gabbros,quartzy microdiorites,granodiorites.

The schistose (trachitoidal) gabbros have gabbro texture and are composed of rounded grains of colourless monoclinal pyroxene,subparallely oriented plates of biotite,which partly overgrowths pyroxene,and of rounded zonal,as a rule with saussuritizated,core grains of plagioclase.

Coarse-grained gabbros also have characteristic gabbro texture. The mineralogical composition of them is as follows: amphibole,monoclinal pyroxene,plagioclase,epidote,magnetite,calcite. Monoclinal pyroxene is observed in the form of small relic grains in colourless amphibole,which in turn is being overgrowthed by light-brown amphibole. Plagioclase (in the composition - labradorite) is slightly epidotizated,forms k large isometric grains,at some places enclosing small irregular nests of calcite.

Quartzy microdiorites have hypidiomorphic-granular texture and have been composed of intensively sericitizated plagioclase,subidiomorphic grains of pale brownish-green hornblendl, flakes of chloritizated biotite

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(common colour index of the rock is near 40) and of abundant interstitial seggregations of quartz. To accessory minerals the grains of magnetite and small grains of sphene are related.

Granodiorites have hypidiomorphic-granular or poikilito-monzonitic textures. In their composition come plagioclase,orthoclase,biotite,hornblend,quartz,epidote,magnetite,leucoxene. Plagioclase is represented by zonal andesine,partly replaced by aggregate of grains of epidote and calcite. Orthoclase sometimes forms oikocrysts,which enclose both the grains of biotite and hornblend and more small idiomorphic plates of plagioclase. Biotite is almost completely chloritizated.

At the left-bank area of the Shulaesh-Darra river at the contact of diorites and marbles x nest-like of irregular form bodies (with the size up to 2 x 5 m.) of skarns and contact-alterated calcareous-siliceous rocks (skarnoides) have been observed.

The skarns themselves have been composed of calcareous-ferriferous garnets,epidote and (in some cases) of clinopyroxene,for all this one of these minerals is usually sharply predominant. Calcite and quartz, making the free place,are also present. Garnet has yellowish or cream-coloured tints; solid masses are isotropic,granular aggregates in calcite often showing zonal anizothropy. Epidote is irregularly coloured in yellow tints,and forms granular or sheaf-like aggregates. Clinopyroxene is colourless,representing by itself ferrosilite. Seggregations of ore minerals are inconsiderable,mainly represented by fine impregnation of pyrrhotite.

In marbles near skarns veinlets of titanomagnetite are quite often met. Their thickness does not exceed IO cm.

G r a n i t e s

The most vast outcrops of granites are situated in the region of confluence of the Rudi-Mandarra river into the river of Rudi-Chal(Bangi), where they compose the Mindarinian intrusive,as well as at the right slope of the Shulesh-Darra river(the right tributary of the Rudi-Chal river wwhere they form the Shuleshdarinian intrusive. In the form of small stock granites are protruding at the distance of 3 km. to the North-East from the village of Samandao too. The Mandarinian intrusive has rounded isometric form. The Shuleshdarinian one - has been composed of two V-like rapproced branches: one of them is lolongated by the right slope of the Shulesh-Darra river at its up-streams,the second one is traced among the outcrops of diorites of the Darrai-Bekhian intrusive. Granites occupy the area of approximately 40 sq.km.

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The Mandarinian and Shuleshdarinian intrusives have been composed of pink,white,greenish-grey,pinkish-white coarse-grained,at some areas porphyraceous granites. For all these rocks mutual intergowths of quartz and microcline are extreamely characteristic,as a result of which graphical and subgraphical textures are formed. The colour index of these rocks is very low - 0.5. Darkcoloured mineral being represnted by primary biotite is almost everywhere replaced by pseudomorphoses of pale-green,almost isotropic chlorite. Among feldspars microcline is the predominant one,and only in some cases the latter is subordinated to albite-oligoclase. Microcline forms large irregular grains,as well as graphical and subgraphical growths with quartz. Albite-oligoclase is observed predominantly in large subidiomorphic grains,rarely in the form of porphyry impregnations; usually inconsiderably,in some cases strongly it has been sericitizated; sometimes by it developed saussuritic aggregate. Sometimes the plates of plagioclase are intensively replaced by grained aggregate of slightly ferriferous epidote. Quartz is met in irregular grains of different size. Its quantity in the rock does not exceed 20-30%. Magnetite is met in small irregular grains.

The apical parts of granite intrusives and their apophyses into the sedimentary country rocks have been composed of granite-porphyries and aplites. In granite-porphyries the porphyry impregnations have been composed of quartz,albite,rarly of chlorite. Quartz is observed in the form of idiomorphic,slightly melted and corroded grains. Albite is met in separate idiomorphic and subidiomorphic,slightly twined crystalls and grew growths. Clorite forms pseudomorphoses by biotite. The ground mass has been composed of isometric grains of quartz and feldspar with the developed at the joints of grains flaky seggregations of chlorite and sericite as well as of grains of ore mineral.

In aplites and porphyry impregnations of microcline and quartz(at some places being somewhat melted) are met. The ground mass has been composed of medium-grained quartz-microcline aggregate and of small interstitial seggregations of muscovite and sericite. In the ground mass the microscopic quartz-microcline graphical growths have a wide distribution.

When granites cut diorites at the marginal parts of granite intrusions at some places contaminated rocks,in the composition corresponding to granodiorites, are met.

With the outcrops of the described granites skarns are spatially connected. They belong to calcareous type and mineralogically analogical to the described in the previous section. Skarns are observed both at the contact of granites and marls as well as at some distance from it -

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- in granites marls and in schists. In granites skarns form lolongated dike-like bodies with the thickness up to IO m. under the extent of several dozens, rarely hudreds of meters. In another cases the form of skarn bodies is irregular(nest-like) and their contacts with the enclosing rocks are not clear.

Granodiorites

Granodiorites form small (6 - 7 sq.km.) of irregular form intrusive which is located near the southern boundary of the investigated region to the West from the village of Darra-i-Shu. From the described above diorites and monzonites these rocks differ for more low colour index (nearly I5) and sharp predominance of biotite over hornblend, and from granites - by more basic composition of plagioclase and by less quantity of quartz. The rocks have hypidiomorphic-granular, monzonite, or poikilito monzonite textures. In their composition come: plagioclase (No.35-42) biotite, hornblend, quartz, orthoclase, monoclinal pyroxene, magnetite, sericite, saussurite, chlorite. At some places granodiorites gradually grade into diorites and quartzy monzonites. These rocks differe from diorites and quartzy monzonites of the first phase by the fact that in them the dark-coloured minerals biotite is the predominant one. In quartzy monzonites, besides it sometimes idiomorphic, being unreplaced by hornblende crystalls of monoclinal pyroxene are met.

The endocontact alterations of granodiorites are expressed in somewhat decreased granularity. The influence of granodiorites on the country rocks and the numerous enclosed in them xenolites were expresed in different degree. Limestones at the contact with granodiorites have not been alterated at all. Schists are everywhere alterated into hornfels. Separate lenses nests and irregular in form areas in hornfels at some places being densely saturated by grains of pyrrhotite, together with which seggregations of chalcopyrite and sphalerite are sometimes met.

Small intrusions of Carboniferous intrusive complex

Into the group of small intrusions of Carboniferous intrusive complex dikes, veins and small stocks of spessarities and gabbros, as well as of plagiaplites and diabases, cutting the described above intrusions of diorites anf granites, also at some places the rocks of the Siadarin and Durumbakian series have been singled out.

Spessartites and gabbros gravitate to the outcrops of diorites of the Pumbakianintrusive, and apparently represent by themselves its vein series. They form steep, meridionally oriented dikes or irregular branching veins being 3-5 m. in the thickness.

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Spessartites have fine-grained ophitic texture and are mainly composed of irregularly oriented laths of plagioclase and interstitial grains of brownish-green hornblend, which composes about 50% of the rock. Sometimes besides it little quantity of augite, partly replaced by hornblend, chloritizated biotite and magnetite is present.

Gabbros have been composed of subidiomorphic grains of colourless monoclinal pyroxene, slightly replaced by pale-green hornblend and by irregular, very irregularly sericitizated grains of basic plagioclase.

Dikes and rare small stocks of plagiaplites and diabases are met both among granites and among diorites and enclosing them rocks. Especially wide they distributed at the left slope of the Rudi-Chal(Bangi)river in the region of confluence in it of the Shulaesh-Darra river, where often cutting of diorites by granites is met. Dikes are especially abundant near the contacts of granites and diorites. The majority of them have thickness of 1-4 m.; they are steeply dipping at the angles of 65-80°. They are oriented usually in meridional direction or close to it ones.

Plagiaplites have been composed of idiomorphic or rounded grains of albite and of enclosing it ground mass, composed of laths of albite, grains of microcline, interstitial seggregations of quartz, flakes of completely chloritizated biotite and small grains of magnetite.

Diabases have medium-grained intergranular structure and being composed of laths of sericitizated plagioclase, pseudomorphoses of chlorite by biotite, rounded grains of monoclinal pyroxene, abundant fibrous and irregular seggregations of ore mineral, small nests of calcite and singular small grains of epidote.

The described dikes of plagiaplites and diabases are the most late formations of the Carboniferous intrusive complex.

The emplacement of intrusive rocks of the Carboniferous complex is connected with the manifestation of tectonic movements during the Variscian time. In relation to these movements the large intrusions of diorites, granites and granodiorites are apparently co-folded, or post-folded.

However, the observed relationship of the described complex with the sedimentary series (it is cutting the Sillur-Devonian and being overlapped by upper Carboniferous-lower Permian) does not allow to date its age more acurately than Carboniferous. It is quite probable, that the emplacement of the Carboniferous intrusions took place during the upper Carboniferous time, simultaneously with the late Carboniferous phase of folding of the Variscian tectogenesis.

In the investigated region with the Carboniferous intrusive complex there are no any considerable manifestations of useful minerals. In the

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zones of contacts the enclosing rocks usually carry slight alterations, expressed either in hornfelization (in the case of contact with schists) or in the formation of reaction-metasomatic rocks(in the case of contact with limestones). Hornfels contain fine impregnetion of pyrrhotite and rarely of chalcopyrite. Skarns and skarned rocks carry poor magnetite mineralization. Hydrothermal mineralization is apparently connected with the described intrusive complex,and also has extreamely poor manifestation being represented by impregnation of sulphides of lead,zinc and copper. Its manifestation are usually confined to the most late formations: zones of crushing and silicification,to quartz veins,contact zones of the dike series. According to the data of heavy concentrate sampling in the regions of the development of the intrusions of the Carboniferous complex the heightened contents in heavy concentrates of minerals of lead and scheelite are marked.

Taking into consideration the mentioned above,on the investigated territory there are no foundation to expect practically interesting concentrations of useful minerals,being connected with the intrusions of the Carboniferous age.

U P P E R-T R I A S S I C - L O W E R J U R A S S I C I N T R U S I V E C O M P L E X

The intrusive rocks of upper Triassic-lower Jurassic complex have been developed in the Central and South-western parts of the investigated territory. The most earlier of them (diorites and quartzy diorites) are cutting and metamorphosing all the deposits up to the upper Triassic ones. In turn they are transgressively overlained by middle-upper Jurassic deposits. The emplacement of theses intrusions took place somewhere at the very end of the Retian age-beginning of Lias epoch.

Upper Triassic-lower Jurassic intrusive complex was formed during several,apparently extreamely rapproched in time phases of magmatic activity. During the first phase the emplacement of diorites and quartzy diorites took place,during the second - of biotitic granites,then during several phases of the intrusive activity small intrusive bodies of aplites,pegmatites,lamprophyries,porphyrites,plagiogranite-porphyries,microdiorites and diabases took place. Upper Triassic - lower Jurassic intrusive complex,described in the Herat province(Mikhailov K.Ja. and others, I965) is four-phased one. The first its phase is represented by diorites the second by plagiogranites,the third-biotitic granites,the fourth-by alaskitic granites.

It is quite probable,that the intrusions of diorites-quartzy diorites and biotitic granites of the describing region are of the same age with

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the intrusions of diorites and biotitic granits in the Herat province. As for the intrusions of plagiogranites and alaskitic granites they have not apparemtly been manifested in the investigated region.

D i o r i t e s a n d q u a r t z y d i o r i t e s

Diorites and quartzy diorites of the upper Triassic-lower Jurassic intrusive complex are mainly developed in the Central and South-western parts of the studied territory. In the Central part of the region they form three intrusives: Piezkulian, Kalagaian and Siadarinian ones. The Piezkulian intrusive (I2 sq.km.) is elongated in the form of narrow strip from the river of Surkhab in the North-eastern direction for I0 km, composing an interstream area of the creeks of Piez-Kul and Larkhob. Its maximal width amounts 2.5 km. In the North-West and South-East it has been cut through by an intrusion of biotitic granites. The Kalagaian intrusive (90 sq.km.) is situated to the East from the village of Kalagai. It has been exposed at the up-stream of the Larkhob river and composing its interstream areas with the rivers of Piez-Kul and Sia-Darra. The intrusive has oval isometric outlines and is traced in latitudinal direction for I5 km. Its maximal width amounts I0 km. At the Central part the Kalagaian intrusive has been also cut through by the intrusion of biotitic granites. It is quite probable, that the Kalagaian intrusive as well as Piezkulian one are the parts of one intrusion, which is being cut through and divided into parts by intrusions of biotitic granites. The Siadarinian intrusive (4 sq.km.) is situated at the up-streams of the rivers of Sia-Darra and Larkhob near the eastern margin of the investigated territory, for all this to the day surface only the western offshoot of this intrusive comes. In the Central and eastern parts the intrusive has been overlained by Cretaceous deposits.

In the South-western part of the investigated territory diorites and quartzy-diorites compose a number of small intrusives and stock-like bodies. The most large intrusive - the Surkhkalinian (I6sqlkm.) is situated at the vicinities of the Surkhkala village. It has been lolongated in the sublatitudinal direction for 9 km., the maximal width being 3 km. From the North the Surkhkalian intrusive has been limited by fractures. In the East it has been cut through by the granites of the Surkhobian intrusive. In the middle part of the Surkhkalian intrusive, besides it, a small cutting body of biotitic granites, which is apparently an apophise of the Surkhobianintrusive is met. At the medium-course of the Ishpushta river three small massifs of diorites, the most large of them reaching the sixe of I sq.km. have been exposed. They are the relics and occur in the form of xenolites among the Surkhobian intrusive of biotitic granites. Small stock-like bodies of diorites and quartzy diorites

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(with the area of 3-4 sq.km.) are observed also at the distance of 3-4 km. down-stream of the Ishpushta river, by the river of Surkhab, near the village of Tala-Barfok, as well as at the right slope of the Saidi-Kaion river valley, at its lower and upper sream, also at the up-streams of the Tun-Darra river.

At the far South-West of the investigated territory, in the Shikarian ravine as well as at the down-sream of the Saihan river, the northern offshoot of a large Saiganian intrusive(55 sq.km.), which is in general situated to the South, involving an area of several hundreds of sq.km., is traced.

At last, in the North-eastern part of the investigated territory, near the village of Nakhrin one more Buzdjilginian intrusive of diorites (i4 sq.km.) is situated. It has been lolongated in the sublatitudinal direction for II km. Its maximal width is 3 km. From the South the massif is cut by a fracture.

Diorites and quartzy diorites cut through all the deposits up to the upper Triassic ones. In their turn they are transgressively overlained (down-stream the mouth of the Ishpushta river) by middle-upper Lias deposits, which are underlained by thick crust of weathering and in the basal horizon contain pebbles of diorites. Besides it, diorites have been cut through by biotitic granites of the describing complex. Intrusions of diorites and quartzy diorites have been composed of very monotonous in outward appearence and material composition medium-grained rocks of grey-green, grey, at some places of pinkish-grey colour. Their texture is massive, at some places - banded. They have hypidiomorphic-granular or prizmatically-granular texture (fig 67,68). Elements of criptic and pegmatoidal texture are marked. The size of grains in diorites and quartzy diorites ranges within the limits of 0.2 up to 0.8 mm. Diorites and quartzy diorites have been composed of plagioclase, hornblend, orthoclase, quarz and magnetite. In some cases apatite, sphene, zircone, epidote, as well as singular grains of olivine and monoclinal pyroxene are marked.

Dark-coloured minerals compose somewhat less than 35% of the rock. Hornblende is intensively coloured in brownish-green, or dark-green colour and form large prizmatic-fibrous and irregular grains, containing sometimes relics of monoclinal pyroxene. Secondary alterations of hornblende have been expressed in its replacement by chlorite, epidote, or carbonate. Besides it, hornblende sometimes is reactionally replaced by biotite. Biotite often is coloured in brown colour; it has been observed in large plates, being from marginal parts, and sometimes completely replaced by pleochroic chlorite, rarely by colourless muscovite; it is in subordinate quantity.

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Light minerals have been represented mainly by plagioclase and quartz. In sharply subordinate quantity plagioclase(orthoclase) is met. The composition of plagioclase ranges from acid andesine to labradorite (No.32-60). It forms large tabular idiomorphic and subidiomorphic seggregations with clear zonality,sometimes being stressed by selective,more intensive replacement of cores by sericite and saussurite. Quartz is observed in solid or granular xenomorphic interstitial grains. At some places growing of interstitial grains of quartz is obsevred in conscequence of supplying of siliceous acid and the appearence in the rocks of section of poikilitic textture. Secondary quartz often corrodes grains of primary minerals,intruding into them by separate branches. Very seldom quartz is observed in pegmatite growths with feldspar. Orthoclase is usually marked in isometric xenomorphic grains. It presents in little quantity and everywhere met. Sometimes the presence of orthoclase conditions the elements of monzonite texture. In some cases orthoclase forms with quartz subgraphical ingrowths. At some places orthoclase metosomatically replaces plagioclase.

Magnetite is observed in small and medium isometric grains,often enclosing hornblende or biotite. Grains of apatite,sphene,zircone and epidote are episodically met.

When the biotitic granites of the second phase of the describing comlex had been emplaced the diorites and quartzy diorites underwent intensive silicification and feldspatization. The processes of silicification were especially widely manifested in the Piezkulian,Kalagaian,Siadarin and Saihanian intrusives. As a result of supply of siliceous acid the very specific silicificated diorites were formed,which are characterized by relic prizmatic-granular and secondary poikilo-blastic textures (fig.69, 70). As a result of the manifestation of potassium metasamotose appeared the rocks of alkiline succession,which apparently should be named as metasomatically alterated monzonites,quartzy monzonites(fig.7I). The content of potassium feldspar in them is increased up to I5%,mainly at the expence of the decreasing of the content of plagioclase and of dark-coloured minerals.

As train seggregations among diorites and quartzy diorites met the areas composed of hornblende gabbro-diorites. They are characterized by more low contents of plagioclase,quartz and by more high content of dark-coloured mineral. Gabbro-diorites are connected with diorites and quartzy diorites by gradual transitions.

Diorites of the Buzdjilginian intrusive are very strongly alterated. Primary minerals in them have been completely replaced by sericite-

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saussurite aggregate,flakes of chlorite,nests of separate grains of calcite and quartz. The distinctive feature of these rocks is expressed by the fact that they contain regular dissiminated impregnation of pyrrhotite,rarely small seggregations of chalcopyrite,and also by secondary markasite.

Intrusions of diorites and quartzy diorites often contain numerous xenolites of country rocks,in different degree alterated and situated without apparent orientation. Their size ranges in wide limits. The most large of them reach 40-50 m. along the long axis. At some places xenolits of sedimentary rocks are piarced by a dense network of the same diorites and quartzy diorites.

Contacts of intrusions of diorites and quartzy diorites with the country rocks in the most number of cases are unclear for the presence of apophyses.

Endocontact alterations of diorites and quartzy diorites are slightly manifested. In the most number of cases in the endocontact rocks the nest-like location of dark-coloured minerals is marked. In the Piez-Kuli and Kalagaian intrusives even at the direct vicinity from the contact the rocks remain to be medium-coarse-grained and have the same hypidiomorphic-granular or prizmatically-granular textures. Their distinctive feature is expressed by high contents of quartz(up to 25%) and decreased contents of plagioclase. The content of dark-coloured minerals is practically remains the same. In little quantity secondary common feldspar is present.

Endomorphism of diorites and quartzy diorites,composing the most large intrusions in the South-western part of the investigated territory was expressed by somewhat desreasing of granularity. Texture of endocontact rocks at some places begins to be close to ophitic;sometimes elements of poikilitic texture are marked.

Exocontact alterations of the country rocks have been expressed in the formation of thin zone of contact hornfels. Quartz-sericitic schists and phyllites of the Siadarinian series,enclosing the Piezkulian,Kalagaian and Siadarinian intrusives,alterated into cordierite,muscovite-plagioclase-quartzy and biotite-plagioclase-quartzy hornfels,in which as an admixture contained ore mineral,apatite and zircone. Marls of the Durumbakian series in small scales being skarned. Sandstones and schists of the Karniian and Noriian stages,cut through by Saihanian intrusion, have been alterated near the contact into quartz-actinolitic and feldspar-quartzy hornfels,in which fine impregnation of pyrrhotite is sometimes observed. The thickness of the zone of hornfeled rocks here at so-

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me places reaches several hundreds of meters. Near the mouth of the Ispushta river the sedimentary rocks of the upper Triassic at the contact with diorites and quartzy diorites have been also alterated into banded hornfels with rare impregnation of sulphides. The zone of hornfels here has the width of not less than 200m. Diorites at the contact are lightened ,epidotizated,enriched by quartz. Effusives and tuffs of middle Triassic age ,enclosing the Surkhakalian intrusive,are almost untouched by the processes of contact metamorphism. In the first relic texture is preserved,in the seconds - psephito-psammitic one. They apparently should be considered as slightly hornfeld effusives and tuffs. With the outcrops of diorites and quartzy diorites,exposing near the mouth of the Ishpushta river,skarns are spatially connected.They gravitate to the contacts of lenses of marls,occurring among schists of the Siadarinian series,as well as near the contacts of marls and diorites. Sometimes the skarned bodies in the form of xenoliths with irregular boundaries areobserved among diorites. The skarns of Ishpushta belong to the most widespread for calcareous-alumosilicated contacts of small and middle depths -calcareous type of skarns. All them,for the exeption of xenoliths among diorites and quartzy diorites,have zonal fabric. Mineral composition and the order of location of zones in general are the same for the all investigated outcrops,being characteristic for calcareous skarns commonly.

Zonality has the following appearence:

I. Marl or marled limestone.

2. Pyroxenic skarn.

3. Pyroxene-garnet skarn.

4. Garnet skarn.

5. Skarned alumosilicated rock.

6. Non-alterated alumosilicated rock (schist or diorite)

The adduced zonality is the summary one - in concrete case this or that zone (most often pyroxene-garnet) is omissed. Skarned zones have irregular form,they often pinched and swelled in thickness,what is especially typical for pyroxene zone. Total thickness of skarned zones amounts 5-I5 m.,but sometimes it reaches 40 m.

P y r o x e n i c z o n e has been composed of dark-green (in thin section pale-green or colourless) ferrosalite,forming mainly sheaf-like growths of fibrous crystalls,reaching 20 cm. in the length. Sometimes the strips of such fibrous composition are alternating with strips of very dense and fine-grained skarn. In some specimens the pyroxenic skarn often contains large nests,vein-like bodies and impregnation of ilvaite.

P y r o x e n e - g a r n e t z o n e has been composed of prizmatic ferrosalite,rounded,irregular grains of garnet and by nests of the

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filling interstices calcite. In well developed skarned contacts this zone is absent.

G a r n e t z o n e has been composed of dense aggregate of isometric grains of garnet,in the composition of which andraditic component is the predominant over grossularic one. In the areas with interstices (filled mainly by calcite) grains of garnet have crystallographic outlines and are very often zonal-anisotropic. Inside the garnet grains in the form of relics the remains of pyroxene,quartz,and chlorite are often met. Sometimes inside garnet abundant relics of green spinel are met. Their presence indicates to secondary development of calcareous skarn by magnesial one,what in turn indicates to the presence of dolomite at the primary contact,underwent granitization.

When the further development of skarned process was going on the back part of the garnet zone,adjacent to allumosilicated rock,was suffering the replacement by vesuvianite or by epidote.In xenolith of the skarned rock among diorites vesuvianitic rock is developed. In case of plained contact at the back part of the garnet zone as well as at the adjacent parts of the alumosilicated rock quartz-calcitic rocks with chlorite,garnet,sometimes with relics of pyroxene (skarned alumosilicated rock) have been developed.

In the described skarned zones a not abundant but various mineralization has been developed. Among ore minerals magnetite,ilmenite,pyrrhotite,sphalerite,chalcopyrite,galena,pyrite,markasite,cuprite are met. The tendency to the localization of oxide (magnetite-ilmenitic) mineralization predominantly in garnet skarns and of sulphide mineralization -- predominantly in pyroxene skarns.

Magnetite and ilmenite (titanomagnetite) mainly form coarse-nest-like impregnation with areas of massive ore. Sulphides form mainly fine-nest-like,sometimes veinlets-like and fine impregnations. Pyrrhotite, chalcopyrite and sphalerite form more large nests and interstitial segregations between columnar crystalls of pyroxene; pyrite and galena - are predominantly small,separate grains or accumulations of impregnated grains. Markasite and cuprite are developed as secondary minerals in the form of rims and veinlets respectively by pyrrhotite and chalcopyrite.

B i o t i t i c g r a n i t e s

Biotitic granites compose several large intrusives (Surkhobian, Zardcharuian,Liarkhobian,Shergolakian,Tundarinian,Narinian) and a number of more small ones. General trend of the majority of intrusives from the South-West to the North-North-East excellently emphasises the general direction of folded structures of the country sedimentary rocks.

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The most large Surkhobian intrusive (about I75 sq.km.) has an extreamely lolongated "cigar-shaped" form. It has been lolongated along the left slope of the Surkhab valley for about 50 km. Its maximal width amounts 7-8 km. The South-western margine of the Surkhobian intrusive is situated at the up-streams of the Ishpushta river, where the Surkhobian intrusive is finished by several branches and by small stock-like bodies. The North-eastern margine of the intrusive is situated beyond the limits of the investigated territory at the right slope of the Surkhab valley to the East from the mouth of the Saidi-Kaion river. From the South the Surkhobian intrusive at a great extent is cut by fracture.

The Zardcharuian, Liarkhobian and Shergoloakian intrusives are situated at the strike of the Surkhobian intrusive to the North-East from the village of Doshli.

The Zardcharuian intrusive (about 22 sq.km.) is located in the mountains of Bandi-Zardcharu. It has been traced in the North-eastern direction for I5 km. Its marginal western part has been exposed at the right bank area of the Surkhab river between the mouths of the Piez-Kul and Larkhob rivers. Here the intrusive has the maximal width, which, however, does not exceed 4 km. To the North-East it is sharply narrowed and then finished by apophysis, being not more than 0.5-0.6 km. in width. In the South-West the Zardcharuian intrusive of biotitic granites cuts through the Piez-Kulian intrusive of diorites, in the North - the diorites of the Kalagaian intrusive. In the South it has been accompanyed by several oval stocks of biotitic granites, with the area of not more than I sq.km., which apparently represent by themselves the apical parts of the Zardcharuian intrusive, have not been exposed by erosion yet.

The Liarkhobian intrusive (about 42 sq,km.) has been located at the middle-course of the Larkhob river (fig. 73). It has near to oval form and lolongated in the latitudinal direction for not less than I2 km At some places its width reaches 5 km. In its southern and western parts the intrusive is in considerable degree overlained by eolian-talus loams. Its boundary with the diorites of the Kalagaian intrusion here is not clear. In the North and in the East this boundary is traced quite clearly. Often on the plan it has a very whimsical configuration.

At the up-streams of the Larkhob river a small Shergolakian intrusive of biotitic granites (about IO sq.km.) is located. From the two sides - from the South and from the East it has been cut by fractures. In the West the diorites of the Kalagian intrusive have been cut through by granites of the Shergolakian intrusive.

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In the North-eastern part the Shergolakian intrusive is partly overlained by transgressively lying deposits of Cretaceous time.

The Tundarinian intrusive of biotitic granites (not more than 6 sq. km.) is located at the up-streams of the Tun-Darra river. In the plan it has an extreamely lolongated form and has been traced from the North-East to the South-West for 8 km., the maximal width being not more than I.5 km. The North-western part of this intrusive is everywhere overlained by Cretaceous deposits.

At the middle-course of the Tangi-Nakhrin river the Narinian intrusive of biotitic granites (about 8 sq.km.) is located. It has been lolongated along a large fracture of North-East-South-Western direction for 7 km.

Separate small bodies of biotitic granites have been exposed, besides it, at the up-streams of the Sia-Darra and Durumbak rivers.

Biotitic granites cutting through and metamorphosing all the deposits up to the upper Triassic ones. Besides it, they cut through the diorites of the first phase of the upper Triassic -lower Jurassic intrusive complex. At the up-streams of the Larkhob river the biotitic granites are transgressively overlained by the lower-middle Jurassic deposits.

With the aim of determination of absolute age of biotitic granites in one of the laboratories of the USSR an analysis of the selected by us from the Surkhobian intrusive samples has been carried out. The analysis has been carried out with the help of argonic method as for the rock as a main and also for the taken from it biotite. The received meanings of age (200 and I55 mill. of years) indicate to the fact that the granites of the Surkhobian intrusive can not be younger then upper Triassic-lower Jurassic. More old age of the rock as a main (what is practically equivalent to its feldspatic part as compare with the age of the taken from it biotite) according to the viewpoint of G.A.Murina, indicates to the possible rejuvenation of the rock under the influence of more late superimposed processes.

Intrusions of biotitic granites have been composed of quite monotonous in outward appearence and material composition rocks, coloured in grey, light-grey, pinkish-grey or greenish-grey colour. They have massive, rarely gneiss-like texture, at some places they have porphyraceous fabric Their texture is typically granitic, sometimes with elements of pegmatoidal and subgraphical (fig. 72). The size of grains in granites ranges from 0.3 mm. up to 8.00 mm. In their composition plagioclase, quartz, common feldspar, biotite, sometimes together with singular grains of horn-

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blende,and also accessory minerals: ore zircone,apatite,rarely -sphene and orthite are met.

Plagioclase in granites is represented by oligoclase. It forms tabular seggregations,often having zonal fabric,for which simple and complicated twins are characteristic. Plagioclase is slightly sericitizated sometimesx by it common feldspar is developed. The grains have wavy extinction. At some places quartz with feldspars forms pegmatoidal and sub graphical growhhs. Common feldspar is being observed in xenomorphic grains. For some of them cruciform twins are characteristic. At some places grains of feldspar have perthitic fabric. Besides the primary-magmatic seggregations of common feldspar in granites metasomatic common feldspar is observed. It has been developed between grains of quarz and plagioclase or fills cutting fissures in the rock. Biotite is observed in subidiomorphic crystalls,at some places it is completely replaced by chlorite and carbonate. Sometimes biotite is enclosing a great number of small grains of magnetite. Hornblende forms prizmatiaally-fibrous grains,by which epidote and chlorite are developed.

Among the biotitic granites the areas composed of porphyraceous granites,adamellites and granophiries are quite often met. They have been connected with the biotitic granites by gradual transitions. The areas, composed of porphyraceous granites,gravitate towards the central parts of the intrusives. They are characterized by the presence of large porphyraceous impregnations (possibly porphyroblasts) of common feldspar with the size of I2-I5 mm. Adammelites and granophyries have been predominantly distributed at the periphery parts of the intrusives. In adammelites as compare with granites there is less content of quartz and more great content of biotite;the balance of feldspars in them is practically the same. In granophyries idiomorphyc porphyraceous impregnations,with the size of up to 3 mm.,composed of acid plagiov lase (oligoclase)No. I5 are observed,the ground mass is composed of the same oligoclase and quartz in the form of ingrowths. In small quantity flakes of chlorite, nest-like accumulations of muscovite and grains of magnetite are met.

In zones of large tectonic dislocations the biotitic granites have underwent an intensive cataclasm and further blastesis. As a result of these processes milonites and cataclasites have appeared,which are characterized by plain-parallel texture and cataclastic,cement,blastocement,blastomilonite structures. The alike formations have wide distribution in the Shergolakian intrusive as well as in the southern part of the Surkhobian intrusive.

The intrusions of biotitic granites contain numerous xenoliths of deeply alterated country rocks and diorites. Especially great amount of

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xenoliths is observed in the eastern part of the Surkhobian intrusive. Here they are possibly the relics of the segged roof.

Near the contact with the country rocks granites quite often grade into granodiorites. Granodiorites have hypidiomorphyc-granular, sometimes with elements of monzonitic texture, and being composed of plagioclase, quartz, orthoclase, hornblende, biotite and magnetite. Dark-coloured minerals occupy about I5% of the rock. Hornblende is mainly forms lolongated prizmatic, rarely irregular grains. Biotite is observed in dark-coloured f flakes, at some places being completely replaced by green or brownish-yell ow chlorite. Plagioclase composes idiomorphic grains, being often intensi vely replaced by sericite and saussurite. Intergranular spaces have been f filled by sub-poikilitic seggregations of quartz and orthoclase.

At some places(the Surkhobian massif) at the zone of endocontact granites have irregular-granular porphyraceous appearence. The y have been composed of large (up to 5 mm.) rounded and sub-idiomorphic impregnations of quarz and plagioclase and of fine-grained (about 0.5 mm.) microclinal-quartzy ground mass, contaning also great amount of pseudomorphes (up to I.5 mm.) of green chlorite by biotite.

Sometimes as a result of the processes of assimilation in the zone of endocontact the specific hybrid rocks are appearing. They are distinctive for their granoblastic texture and have been composed of andesine, amphybole, quarz, and ore mineral. In these cases it is difficult to determine a boundary between the intrusion and country rocks.

At some places the endo-contact alterations of granites have been expressed in the decreasing of granularity, for all this the fine-grained granites sometimes contain abundant impregnation of pyrite. The thickness of the zone of endo-contact rocks in the most number of cases (when the contact is steep) does not exceed I50-200 m.; when the contact is gentle it is sharply increased. Near the contact with the country rocks in granites usually observed a slight orientation of dark-coloured minerals (mainly of biotite). Biotitic granites have a great influence on the enclosing rocks. For all this the scale of processes of contact metamorphism is directly dependent on the character of the contact. Under a steep contact the thickness of the zone of alterated rocks amounts usually the first dozens of meters. Under a gentle one- the thickness of the zone of alterated rocks is sharply increased, reaching several hundreds of meters. For all this, migmatitic rocks have been developed here, the distinctive feature of which is a leaf-by-leaf and ptygmatic injection of granitic material. They possess a granolepidoblastic texture and have been composed of quartz, plagioclase, biotite, amphibole and ore mineral.

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Usually in them strips of different inrichement by dark-coloured minerals are singled out. The alike formations have a wide distribution at the eastern offshoot of the Surkhobian intrusive.

In the conditions of steep contact phyllites are usually alterated into biotite-plagioclase-quartzy, sometimes into cordieritic hornfels. Limestones are marly, and directly near the contact they are in small scale skarned. Effusives are not considerably alterated. At some places in the endo-contact rocks an abundant impregnation of ore mineral (mainly of pyrite) is marked.

Apogranites

Side by side with the Tundarinian intrusion of biotitic granites a small stock of apogranites (I sq.km.) is located. In the composition of apogranites both primary magmatic minerals - oligoclase, partly quartz and feldspar and secondary appeared as a result of metasomatic processes - muscovite, albite; partly quartz and common feldspar are present. Near the contact with the country sedimentary rocks in apogranites small grains and veinlets of molibdenite (with the diameter up to 4 mm.) are observed. With the help of spectral analysis in apogranites besides it the presence of niobium (up to 0.03%) tantalum (up to 0.3%), tin (up to 0.0I%), traces of berrilium, lantanium (up to 0.06%), yttrium (up to 0.0I%) and of ytterbium (up to 0.003%) has been established.

Small intrusions of upper-Triassic-lower Jurassic intrusive complex

Small intrusions of the upper Triassic-lower Jurassic intrusive complex have been singled out in the central and South-western parts of the investigated territory. They have been represented by numerous dikes, veins and stocks of aplites, pegmatites, lamprophyries, porphyries and plagiogranites, as well as by more reare , being non-singled out on the map dikes of microdiorites and diabases.

The emplacement of small intrusions is related to the final stages of the magmatic activity of the upper Triassic-lower Jurassic time. All of them are cutting through not only the intrusions of diorites and quartzy diorites, but the more late intrusions of biotitic granites as well.

The relative sequence of the emplacement of small intrusivebodies is not quite clear. The most earlier are apparently aplites, pegmatites which were emplaced directly after the large intrusions of biotitic granites; the most late ones - are plagiogranite-porphyries. In the rest

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the sequence of the emplacements remains to be not quite clear. Lamprophyries had apparently emplaced directly after aplites and pegmatites, they cut the latter and being spatially related to them.Porphyrites are more young as compare with plagiogranite-porphyries. Everywhere cutting of the first by the latter is observed. There is nothing known about the emplacement of microdiorites and diabases yet.

Aplites and pegmatites have been predominantly distributed in the basins of thr Larkhob and Sia-Darra rivers. They form veins,dikes and irregular in form stock-like bodies,mainly in the sublatitudinal direction. Veins and dikes of aplites have the thickness from several cm. up to several meters. The thickness of veins of pegmatites usually ranges within the limits of I.5-5 m. Their extent does not exceed several dozens of meters. The area of stock-like bodies of pegmatites usually does not exceed 0.4-0.6 km^2.

Pegmatites and aplites have been mainly composed of quartz,common felspar (microcline,microcline-pertite and materially sodium plagioclase) biotite and muscovite. Of accessory minerals apatite,zircone and ore mineral are marked in them.

Veins and dikes of aplites and pegmatites are especially abundant at the contact of granites with country rocks and diorites. That is why there is afoundation to suppose that they genetically related to them.

In the mineralogical composition the pegmatites of upper Triassic-lower Jurassic intrusive complex are related to the class of simple pegmatites. Any of rare minerals have not been discovered in them. Many of pegmatitic bodies have quite clearly pronounced zonal structure. An internal,predominantly microclinic and inner-predominantly quartzy zones have been singled out in them. The rim parts of some pegmatitic bodies have been composed of graphically ingrowthed microcline-pertite and quartz Some pegmatites have been formed apparently as a result of replacement of more fine-grained aplites,as they are observed in the central parts of aplitic veins and dikes.

Lamprophyries have been distributed in the same regions as aplites and pegmatites,but they are quite rarely met. Lamprophyries form dikes and rare veins ,which do not show regular orientation in the space. Dikes of submeridional direction -being cross in relation to the more young dikes of aplites and pegmatites. The thickness of dikes and veins of lamprophyries in the most number of cases does not exceed 0.2-0.4 m.,and the extent - 30-40 m.,however,sometimes dikes reaching 8 m. in the thickness and several hundreds of meters in the extent are met.

Dikes and veins of lamprophyries have been composed of spessartites and odinitr

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and odinites.

Spessartites and odinites possess a prizmatically-granular texture They have been composed of lath-like grains of plagioclase (oligoclase-andesine),in considerable degree being replaced by secondary saussurite aggregate and by serisite as well as fibrous crystalls of light-green actinolite,developed by brown hornblende. In odinites impregnations of hornblende,sometimes forming glomeroporphyric growth are met. In little quantity grains of ore mineral are also present. In the interstitions common feldspar is met.

Porphyries compose a number of dikes,being especially abundant in the region of village Doabi-Mekhzarin as well near the mouth of the Ishpushta river,forming several stocks,located at the left slope of the Surkhob valley near the village of Tala-Barfak. One of these stocks is located at the up-stream of the nameless valley,connected with the valley of thr Amir-Omad river. Another two have been exposed at the left slopes of the Turmush and Wodu creeks,directly at the confluence of them with the river of Surkhab. At last,the most large stock has been located at the middle-course of the Nalaka river.

Stocks of porphyrites cut through the upper Triassic deposits(including the effusive rocks of the Ret stage). At the meium-course of the Nalak river one of the stocks is transgressively overlained by lower-middle Jurassic deposits. Dikes of porphyrites cut the intrusions of diorites,which belong to the upper Triassic intrusive complex,and in turn being cut by veins of plagiogranite-porphyries near the mouth of the Ishpushta river.

Stocks of porphyrites have irregular isometric outlines. The area of the most large of them amounts approximately 7 sq.km.,the rest have an area of 0.5-I.0 sq.km. In some stocks a columnar jointing is clearly pronounced. Spherical forms of weathering are rarely observed. At the contacts with the stocks of porphyrites the country rocks remain almost unchanged. Endocontact alterations in the stocks of porphyrites are also slightly pronounced (in the zone 0.5 m. from the contact the decreasing of granularity is observed,as well as dissappearence of impregmations and offshoots of the rocks) In the basin of the Nalak river the stocks of porphyrites are cut by dikes of the alike in composition rocks.

Dikes of porphyrites in the most number of cases have sublatitudinal direction,but some of them have been lolongated in the North-western or in the North-eastern direction. Nearly all of them are cross-cutting and steeply-dipping (75-85°,rarely 55-60°). The thickness of dikes usually mesured by I-2 meters,some of them have the thickness of I0 m. From the

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cross-cutting dikes into the country rocks sometimes come apophyses, being up to I m. in the thickness, occurring concordantly with the enclosing rocks. Along the strike apophyses sometimes traced for 30-40 m. At some places the cross-cutting dikes are bended and from cross-cutting grading into bedded. Sometimes met bedded bodies of porphyrites (the region of the Doabi-Mekhzarin village), being unconnected with the cross-cutting dikes. Usually they have a considerable thickness - from IO up to 50 m.

Porphyrites, composing dikes, in the outward appearence, mineralogical composition and texture are very close to porphyrites, forming stocks. Among them augitic, bipyroxenic, hornblended porphyrites and alterated porphyrites, in which dark-coloured mineral has been replaced by calcite, chlorite or by both of them, are singled out. All these rocks possess porphyritic texture. Impregnations in them usually compose IO-20%. As in the main, they have been composed of plagioclase. Impregnations of plagioclase have idiomorphic and subidiomorphic outlines and the size of up to 3 mm. Plagioclase of the impregnations has the composition from medium andesine up to medium labradorite (in bipyroxenic varieties), it has been often intensively saussuritizated.

Impregnations of augite remain to be fresh; they have rounded, rarely prizmatic outlines. Impregnations of hypersthene, as a rule, have been intensively replaced by saponite. Sometimes large crystalls of biotite have been replaced by saponite, but mainly biotitic impregnations have been replaced by pale-green pleuochroic chlorite. Calcite forms coarse-grained pseudomorphes by dark-coloured minerals, as well as large nests with curved outlines among the ground mass. The ground mass of porphyrites is fine-grained; it has intersertal texture; it has been composed of plagioclase, augite or chlorite and ore mineral/ In some cases in the composition of the ground mass comes quartz.

Plagiogranite-porpyries compose a number of small stock-like bodies, being exposed at the vicinity of the Ferozak and Madrak villages, at the down-stream of the Saihan river, and at the left slope of the Piez-Kul valley. They also form a number of dikes (oriented in the North-eastern, as well as in the meridional direction), being qiute widely distributed near the village of Doabi-Mekhzarin, near the mouth of the Ishpushta river, as well as at another places. Dikes and stocks of plagiogranite-porphyries cut through the deposits of the lower Paleozoic and of middle-upper Triassic age, they also cutting the more young dikes of porphyrites the skarned rocks, occurring in the endocontact of the intrusion of diorites, being exposed near the mouth of the Ishpushta river, they cut ~~threu~~ through the granites of the Surkhobian intrusive.

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The y are the most young formations in the complex of intrusive rocks, which emplaced at the end of Triassic or at the beginning of Jurassic periods.

Dikes of plagiogranite-porphyries often have lens-like structure. They are now swelled,now pinched in the thickness. The thickness of the most large of them ranges from 5-6 up to 50 m. The majority of dikes of plagiogranite-porphyries are steeply dipping. The angles of dipping of dikes usually are within the limits of 60-80°,but they sometimes are flatten out up to 35°. In the region of the mouth of the Ishpushta river dikes of plagiogranite-porphyries are especially abundant. At some places here in zone being in width of 250-300 m. there are about I0 parallel each other bodies of lensing dikes,with the thickness from 3-5 up to I5 m. It is interesting that part of them is confined to fractures or being oriented parallel to the dislocations of Pre Jurassic age.

Stock-like bodies of plagiogranite-porphyries,exposing in the vicinity of the villages of Ferozak and Madrak have an extreamely curved configuration. The most large of the known here stocks-like bodies occupies an area of approximately 5 sq.km. The area of the rest bodies does not exceed 0.5-I sq.km. Stocks of plagiogranite-porphyries,exposed at the left slope of the Piez-Kul valley at its middle-stream,have lolongated-oval outlines. They occur conformably with the bedding of the sedimentary country rocks. The central parts of the most large stock-like bodies is usually better crystallized. They have been composed of porphyraceous plagiogranites. At the apical parts as well as at the marginal ones of the stock-like bodies occur rocks,qiute alike those,which are composing the described above dikes. The country rocks near the contact with stock-like bodies of plagiogranite-porphyries at some places are strongly alterated and contain fine abundant impregnation and veinlets of pyrite.

Plagiogranite-porphyries,composing dikes,have sometimes a transitional to porphyraceous texture. Porphyry impregnations(occupying up to 20% of the rock) have been composed of quartz and acid plagioclase(albite-oligoclase) as a rule being strongly alterated by sericitization and pelitization. In some cases the impregnations of plagioclase are pseudomorphycally replaced by calcite. Quartz forms idiomorphic and subidiomorphic,sometimes melted and corroded impregnations with the size up to 2 mm 2 mm.;plagioclase forms idiomorphyc plates with the size up to 4 mm. In the most number of cases among the impregnations plagioclase is the predominant. Sometimes separate subidiomorphic impregnations of muscovite are met. The ground mass is finegranined up to very finegrained,being of

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granite or aplitic texture as in the main. It has been composed of laths and irregular grains of albite,feldspar,muscovite,quartz and magnetite, sometimes with nests of calcite.

Porphyraceous plagiogranites,exposing in the central parts of the stocks have porphyraceous structure. They have been composed of sub-idiomorphyc impregnations of slightly zonal plagioclase with the size of the latter being up to 3 mm. in diamenter and of medium-grained (up to 0.5 mm.) ground mass,being composed of plagioclase(oligoclase),quartz and little amount of common feld spar. The texture of the ground mass is aplitic.Sometimes side by side with plagioclase in impregnations observed rounded grains (up to I.5 mm.) of pale-green hornblende,by the rims being replaced by chlorite,as well as pseodomorphes of chlorite developed apparently by biotite. Accessory admixture usually make small dissiminated grains of ore mineral and small nest-like accumulations of small grains of epidote.

Microlites and diabases compose rare dikes,cutting through the Surkobian,Narinian and Zardcharuian intrusives of biotitic granites.

Dikes of microdiorites are rare,being the most thick (up to 50 m,) Microdiorites have allotriomorphic-granular texture and being composed of aggregate of irregular grains of often chloritizated green biotite, bluish-green hornblende,intermediate plagioclase,quartz and small seggregations of leucoxene.

Dikes of diabases are more often met,but their thickness in the most number of cases does not exceed I m. Diabases have porphyraceous-subophytic texture,being composed of rare subidiomorphic (up to 2 mm.) semidecompdsed (chlorite,epidote,sericite,saussurite) impregnations of basic plagioclase and of medium-grained ground mass of sub-ophytic texture being composed of lolongated laths of labradorite(No.70) and of interstitial seggregations of hornblende,chlorite,magnetite and little quantity of quartz.

The manifestation of magmatic activity at the very end of Ret -beginning of Lias time is connected with a specific semi-platform stage of the investigated area's development. The emplacement of large intrusions of diorites and granites apparently coinsides with the manifestation of the main tectonic movements,while the emplacement of small intrusiona is related to the more late time.

With the complex of upper-Triassic-lower Jurassic intrusive rocks is connected the small in scale showings of useful minerals. In the zones of contacts with the enclosing rocks,as it was pointed out above, either zones of hornfels with an impregnation of pyrrhotite,or reactio-

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nal-metasomatic rocks with slight magmetite-ilmenite-pyrrhotite mineralization are met. Mineralization connected with the more late hydrothermal process has more slight manifestation. It has been represented by sulphides of copper, lead and zinc. Besides them, with the help of spectral analysis tin, silver, cadmium and bismuth have been established here. The sulphide mineralization is spatially connected either with zones of contacts, being superimposed on skarned and skarnizated rocks(Darra-i-Alasang), or being manifested at some distance from the intrusive rocks in the form of poor impregnation in zones of hydrothermally alterated rocks(Ishpushta, Tangi, Ishpushta).

At the areas of the distribution of intrusive rocks of the describing complex with the help of heavy concentrate method the heightened concentrations of minerals of lead, copper and zinc, scheelite, rarely of thorite and cinnabar have been established.

Hydrothermal mineralization related to the upper Triassic -lower Jurassic intrusive is apparently the manifestation of the most late magmatic activity, being clearly pronounced in the investigated region.

With the intrusions of the describing complex and apparently with the intrusions of dioritic composition there paragenetically could have been connected zones of ore manifestation of polymetals, which can be of practical interest.

U P P E R J U R A S S I C I N T R U S I V E C O M P L E X

Intrusive rocks of the upper Jurassic intrusive complex have been singled out in the North-Eastern part of the investigated territory: at the middle-course of the Tangi-Nakhrin river, near the village of the same name, at the two slopes of the Rudi-Chal valley, as well as in the region of the Chashma-Gavan village, at the left slope of the Farkhar valley near the villages of Narianu, Kandaku and Dashti-Rubo.

The main outcrops of the intrusive rocks of the upper Jurassic complex have been concentrated within the limits of the distribution of the Upper Triassic and Jurassicformations. The most young deposits, which they cut through, are related to the Callovian stage of the upper Jurassic. Deposits which overlain these intrusions are not known. The fact of the absence of intrusive rocks among lower Cretaceous and more young deposits in the investigated region is doubtless. That is why, the emplacement of the cosidering intrusive formations could have apparently taken place during the Pre lower Cretaceous time. Most probably it is related to the very end of the Jurassic period, or to the border of Jurassic and Cretaceous period. The upper Jurassic complex of small intrusions has

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been represented by small (up to I.2 sq.km.) stocks of diabases and by cutting or sheet-like(which are more often met) dikes,as well as by still small(0.4 sq.km. and less) stocks of intrusive spilites,andesites and andesito-basalts. Sheet-like dikes of kersantites are extreamely rare.

Diabases and intrusive spillites

Among the intrusive rocks of this group the most widely distributed are diabases. 4 km. to the East from the village of Nakhrin at the two slopes of the valley of the same name river,as well as at the left slope of the Farkhar river valley near the villages of Narianu and Kandaku diabases form separate dome-like protruding stocks with clearly pronounced columnar jointing. Diabases have unclearly pronounced porphyritic texture. The ground mass has an intergranular,sometimes transitional to subophitic texture. In some cases diabases show poikilovitic texture. They have been composed of plagioclase,monoclinal and orthorhombic pyroxenes magnetite and secondary minerals: sericite,saussurite,saponite,chlorite and leucoxene. Plagioclase forms irregularly oriented lolongated laths, the most large of them are porphyritic impregnations. Crystalls of plagioclase are everywhere have clearly pronounced zonality.The composition of plagioclase ranges from No.65 up to No.80. As a main,plagioclase is quite fresh,but at some places it has been replaced by sericite,saussurite and chlorite. Dark-coloured minerals have been represented by monoclinal pyroxene and hypersthene. Monoclinal pyroxene forms small dikes, porphyraceous phenocrysts of irregular form and small intergranular grains in the spaces between the laths of plagioclase. Usually it is fresh,sometimes replaced by chlorite;it has comparetively low angle of optical axis,it is colourless. Hypersthene forms subidiomorphic porphyraceous phenocrysts and small intergranular seggregations. It has a ~~slig~~ slight pleochroism. Intensively,at some places completely,it has been replaced by scurfly aggregates of brownish-yellowish pleochroic saponite.

Magnetite forms idiomorphic grains and irregular seggregations,sometimes being replaced by the rims,and sometimes completely by leucoxene.

Spillites occur in the form of quite numerous steeply dipping dikes with the thickness 2-5 m.,or in the form of interstratal bodies,being up to 30 m. in the thickness. Rarely they form small stocks. Dikes of spillites have the most wide distribution near the village of Narin,where they intruding the upper Triassic and Lower-middle Jurassic deposits. In the South-western part of the investigated region dikes of spilites were met among the metamorphic schists of the Siadarinian series,exposed

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in the region of the Ishpushta village. Stocks which are composed of intrusive spilites,have been met: one -at the distance of 5 km. to the East from the village of Nakhrin at the lefr slope of the same name valley,the second - at the left slope of the Nakhrin valley near the village of Dashta-Rubo.

Stock of intrusive spilites,exposed at the left slope of the Tangi-Nakhrin valley,in the direction to the West is grading into bed-like body,being splinted by the benches of hornfeled sedimentary rocks,in which the cutting veinlets of white quartz,concretions of chalcedony, calcite,rarely nests of semi-transparent of Iceland spar are met. Sometimes from the bed-like body of intrusive spilites into the enclosing rocks the thin(up to 20-30 cm.) cutting veinlets,composed of aphanitic basaltoides have been offshooted.

Spilites have porphyraceous texture. The size of porphyritic phenocrysts,amounting from IO up to 40% of the rock,does not exceed 2 mm. They are mainly represented by albite,hornblende,calcite,green and yellow chlorite,sometimes by augite and semi-destroyed biotite. Albite forms idiomorphic and sub-idiomorphic phenocrysts,being unzonal,slightly twined,in different degree sericitizated. Green(blue-green) hornblende is observed in lolongated sub-idiomorphic phenocrysts and granular growths; in some cases these growths have been overgrowthed by albite. In many cases large nests of coarse-grained calcite,being of rectilinear outlines and apparently being pseudomorphes by phenocrysts of plagioclase are met. Abundant in some cases pseudomorphes of green and yellow chlorite apparently replacing phenocrysts of hornblende and biotite.Augite is met in the form of large (up to I.5 mm.) corroded seggregations. Biotite is observed in the form of medium-sized (up to 0.5 mm.) thick-platy phenocrysts,being intensively chloritizated along the cleavage.

Fine-grained ground mass possess mainly intersertal texture. The spaces between laths of albite are filled by chlorite,calcite,ore mineral,and in sone cases by glass.In a number of cases the ground mass showing a clear fluidness. The content of secondary calcite in the ground mass sometimes reaches 40%.

Kersantites are met at one place only near the pass of the Kotali-Chal,where they in the form of stratal dike,being not less than IO m. in the thickness,occur among the lower-middle Jurassic deposits. The rocks have been composed of differently oriented laths of biotite(up to 2 mm.),separate grains and small laths of augite and fine-grained strongly chloritizated and sericitizated ground mass,in which different

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by size and shape nests of calcite and magnetite are abundant.

Intrusive andesites and andesito-basalts

Andesites and andesito-basalts form numerous steep,meridionally oriented dikes up to 3 m. in the thickness,rarely sheet-like bodies with the thickness up to I00 m.;they also compose a number of small stocks. Dikes of andesites and andesito-basalts gravitate towards the outcrops of the upper Triassic effusives,being exposed in the region of the Nakhrin village. At some places these dikes enclose xenolithes of the country rocks. The sheet-like bodies and stocks occur among the lower-middle Jurassic deposits,outcropping near the village of Chashma Gavan. Stocks occur conformably with the enclosing rocks.Near the contact,which is often curved the enclosing deposits remain to be almost unchanged. At some places in stocks an inclined and vertical jointing is clearly pronounced.

Andesites and andesito-basalts have porphyritic texture. Phenocrysts have the size up to 2.5 mm. and compose not more than 25% of the rock's volume. They have been mainly composed of plagioclase,which forms idiomorphic or sub-idiomorphic grains,being mainly fresh or slightly alterated,but in some specimens they are strongly sericitizated,and carbonatizated. Besides it,in phenocrysts chlorite,hornblende,sometimes augite, and in singular cases- hypersthene are present. Chlorite represents by itself apparently pseudomorphes by biotite and hornblende.Augite is met in small slightly corroded grains of idiomorphic outlines.Hornblende and hypersthene form lolongated idiomorphic crystalls and growths,being mainly alterated. In some cases large grains (up to 0.5 mm.) ore mineral forms too.

The ground mass is composed of fine-grained (sometimes microgranular aggregate of plagioclase,chlorite,epidote and ore mineral. In some cases the ground mass in considerable degree (up to 30%) is replaced by fine-grained calcite;fluideness in the texture is not met.

In the investigated region with the complex of the upper Jurassic intrusive rocks there are apparently not related any noticeble manifestations of useful minerals.

U N D I S S E C T E D I N T R U S I V E R O C K S

In the group of undissected intrusive rocks we have singled out the intrusions of hyperbasites and alaskitic granites,the age of which can not be yet precisely determined. For example,concerning hyperbasites it is known that they cut through not only the lower Carboniferous but the more young formations as well.

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Ultrabasites

Ultrabasites have been represented by intrusions of serpentinites, which have the form of small stock-and lens-like bodies with the area up to 0.3-0.5 sq.km.

Five of them are marked at the up-streams of the Pashagol river near the village of Kalaimurat, two of them - at the left-bank area of the Saidi-Kaion river near the same by name settlement.

Serpentines have micro-platy, micro-granular, rarely lattice structure and is mainly composed of antigorite, chrizotile and serpophite. In noticeble quantities presents chromite(I-4%) and magnetite(I.5-4%). Chromite forms isometric grains, the diameter of which being up to 2 mm. Magnetite is evidently secondary one. It composes chains of small grains and veinlet seggregations. Sometimes porphyroblasts with the size of 3-6 mm. are observed. Often among serpentinites small zones of talced rocks with the size 20 x 50 m. are observed. The talced rocks at some places have been pierced by thin (3 mm.) unpercistent along the strike veinlets of chrizotile-asbestos.

The body of serpentines, located at the left-bank area of the Caidi-Kaion river to the West from the settlement of the same name, has been divided by a network of irregularly branching veins of amphibole-asbestos with the thickness of these veins being up to I m.

A L A S K I T I C G R A N I T E S

Alaskitic granites compose a leaf-by leaf and ptygmatitic injection among the metamorphic schists of the lower-middle Paleozoic age and among the deposits of the Tundarinian series. The thickness of the injections reaches 7-8 m. They have been traced along the strike for hudreds of meters following the folding of the country rocks. Often the alaskitic granites form lens-like and stock-like bodies with the area of the latter being up to 0.5 km^2. The most large of them have been observed along the river of Surkhob, somewhat to the South from the town of Puli-Khumry as well as at the left-bank area of the Saidi-Kaion creek, near the settlement of the same name.

Alaskitic granites represent by themselves coarse-grained slightly gneiss-like rocks of pinkish-white, white, yellowish and grey colour. They have both relic granitic and secondary blastocement texture which had developed as a result of cataclasm and further blastesis. The x size of grains ranges within the limits from 0.2 up to I5.0 mm.

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The rocks have been composed of oligoclase, quartz, common potash feldspar muscovite. Accessories have been represented by ore mineral, apatite, rarely by sphene and garnet.

Plagioclase is slightly sericitizated. Quartz forms cataclasites of irregular form. Common potash feldspar is often latticed almost unchanged. Muscovite is mainly secondary, it has been developed by biotite and by common potash feldspar. Garnet(almandine?) is observed in rounded grains with the size of the latter being 0.4-0.8 mm.

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U S S R

V/O T E C H N O E X P O R T

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ROYAL GOVERNMENT OF
AFGANISTAN
MINISTRY OF MINES AND
INDUSTRIES
DEPARTMENT OF GEOLOGY
AND MINES

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R E P O R T

ON GEOLOGICAL-SURVEYING WORKS OF I:200000SCALE ON THE COAL BEARING AREAS OF NORTH-WESTERN AFGANISTAN. THE SHEETS 222-C, 502-D, 503-B. THE PARTS OF THE SHEETS 221-F, 222-D, 222-F, 502-A, 502-B, 502-C, 502-F, 503-A, 503-C, 503-D , 503-E, 504-A.

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PART II

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CHAPTER I.

TECTONICS

The first view at the geological map shows that the main part of the described territory is closed by dislocated mantel of the Cretaceous,Paleogene and Neogene deposits.Only along southern and south-eastern frame are exposed the Paleozoic folded formations,sometimes occurring as well in cores of outwashed anticlinals and in some erosion windows in the central part of the area. The Triassic and Jurassic deposits are exposed by the line of the Paleozoic and Cretaceous formations , as well as in erosion windows in the west part of the area. The above mentioned strata are dislocated differently.Sometimes they are divided by regional unconformities which shows the complicated development history of the investigated territory.In its limits can be singled out the Paleozoic (Variscian) folded formations,mantel of Mesozoic platform occurring on them and the end part of the Alpian folding area (see tectonic map,zones I,II,III and IY).

The Variscian folded formations,being subjected to the Early-Alpine (Cimmerian) alteration plunge to the North (often steeply, by system of large fractured faults), covering by thick platform mantel. The platform mantel is subdivided into the Triassic--Jurassic,Cretaceous-Paleogene and Neogene- Quaternary complexes. They are dislocated to different degree,being subjected to the covering folding at some periods of the tectogenesis Alpine epoch. The Alpine folding area is represented ## in the investigated territory by its end part,ended within the limits of the area by the foredeep and edge ancient mass (crumpled into foldings already by Variscian tectogenesis),involved in the area of the Alpine geosinclinal of the Gimalai-Beludzhistan.

The Variscian formations are exposed on the square of about I200 km^2, the Alpine formations (the foredeep and edge ancient mass) occupy the square of 300 and 700 km^2 The rest territory (about I2000 km^2 represents the Mesozoic platform.

I.The Variscian folding areas.

Among the Variscian folded formations are singled out three structural stages, divided by the surfaces of angle unconformity.

Besides, among them can be observed small areas of earlier folding and consolidation,playing in the epoch of the Variscian folding the role of rigid ancient cores and reacting upon the new tensions by block shifts and fractured formations. They are formed by the Proterozoic (?) formations of Fulul suite,represented by gneisses,crystalline shists and amphibolites.They are exposed in the form of small tectonic blocks along the Fulul and Rud-i-Chal rivers.The rocks are crumpled into numerous small foldings, complicated by additional folding up to plication.With the most ancient Paleozoic deposits they contact only by fractures and ~~places with sharp unconformity~~ only by places with sharp unconformity they are overlapped by the late Paleozoic formations.For example in the uppers of the Khodzha Bin river occure the formations of the upper structural stage (the Upper Carbonaceous- the Low Permian.)However the methamorphism of the Proterozoic (?) formations is higher in comparison with the Paleozoic deposits.That is why we can suppose that they were influenced by the folding and methamorphism as the result of the Pre-Cambrian foldings.

The low structural stage of the Variscian folded area is monotonous,envelops the deposit strata of considerable stratygraphic volume (from the Low Paleozoic up to the Viseian). It has thickness of 9000 m.It is formed of different geosinclinal formations: aspide and spilite-keratophire in the Low Paleozoic(having then methamorphism at the level of green schists and almandine-amphibolite facies), the Cretaceous in the Cilurian -Devonian, as well as fracture- vulcanogene strata of the Upper Devonian- the Turne and Carbonaceous-fractured - the Viseian.It is interesting that for the Upper Devonian--Vise in the direction from the North to South takes place the gradual changing of the Carbonaceous deposits into the fractured ones,increases the role of effusive formations. In the southern part of the area between the Low Paleozoic and Cilur-Devonian is observe

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stratygraphical unconformity,because to the North they are connected by the gradual transition.These fenomena apparently, are explained by the synchronic with sedimentatio and slow uplifting of the area situated to the south (this process was over at the beginning of the Mesozoic by the formation of the Gindukush meganticlinorium).All the mentioned strata are crumpled into the foldings at the end of the Viseian- Namurmian stage.No one can mention the surfaces of the angle unconformity between separate strata in a single structural stage.One can mention only a small washout between the Low Paleozoic and Cilur-Devonian,as well as at the basement of the Vise.However,in the whole all the strata of the formations of the Low structural stage as crumpled uniformly not taking into account the disgarmony of the foldings of the heterogeneous strata by lythology. The latter is specially typical for the bedded strata of the methamorphic schists of the Siadarian suite and the strata of massive limestones of the Cilur-Devonian.For example, the outcropping in the core of the Iefandzha anticlinal (I7 +) the deposits of the Low Paleozoic are crumpled into numerous small foldings, and conformably overlapping them the Cilur-Devonian formations contour the larger and simple anticlinal of the rounded form with tucked up SW wing.Some of the foldings in the formations of the low structural stage are characterised by small length (up to several km); very often they are assymetric or even overturning (fig. 74).

The stratygraphical volume (the Low Paleozoic- Vise) of the low structural stage shows certainly that within the limits of the investigated square the Calendonian folding did not take place.The Paleozoic geosynclinal territory development is characterised by the uncompliteness of the Calendonian stage,having no independent meaning.

Middle structural stage is formed by clayer-sandstoneous deposits of the Calaimuratian suite of the Middle-Upper Carbonaceous and ,apparently, of the Farkharian suite of unseparated Carbonaceous reaching thickness of 2500 m. The formations of the middle stage cover shorter interval of time (than the low structural stage) and are distributed with more limits.They compose separate troughs in the low structural stage, occurring on its different horisons (the Vise,or the Tundarian suite) with some azimuth and angle unconformities usualy in different structural plan. The middle structural stage is also crumpled into the foldings of small length,often assymetric and complicated by the folding of more smaller orders. The folding last stage ,apparently, had place in the Upper Carbonaceous.Very likely that with this stage is connected impregnation of the intrusive complex of granitoids (breaks Cilur -Devonian and transgressive ly is crossed by the Upper Carbonaceous deposits-the Low Permian).In this case the intru sive formations are synorogene formations of the Variscian folding.

Upper structural stage is formed by the formations of the Upper Carbonaceous- Low Permian and Sacmarian and Artinian stages,reaching thickness of II00 m.This structural stage also includes the Upper-Permian deposits developed to the South.The upper stage formation was transited into final Variscian folding stage,apparently, at the end of the Upper Permian or in low Triassic. The formations of the upper structural stage form the most flexured areas in the limits of the Variscian folding area,usualy forming small isometric fields.Separate foldings in general have the same peculiarities that is in more lower structural stages.

As the Variscian folded formations are exposed in the raw of erosion windows (Sandi-Kaen,Kalai-Murat,etc.saia) in the central part of the area,it is unlikely that the Paleozoic geosynclinal occupied in its time the whole investigated territory.But now paleozoids at the largest part of the area form the folded basement of the Mesozoic platform (see below).

Later,during the Mesozoic and Cainozoic epochs, periods) they were very intensive and subjected the Variscian folded formations to un-consolidated finally by the Variscian tectogenesis the territory many times underwent the further tectonic tensions.Sometimes, for example, in Cimmerian epoch,that is in the Triassic and Jurassic, they were very intensive and subjected the Variscian folded formations to the alteration.The latter is expressed partially in renovation and mainly, in formation of new numerous fractures,divided into separate tectonic blocks of small

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sizes and block shifts and finally, in active intrusive activity at the end of the Triassic - at the beginning of the Jurassic . The coarse intrusive massives of granitoids are situated mainly among the Paleozoic folded formations.That is why we can suppose, that their impregnation took place in the central parts of the most positive structures of that time.At the following epochs of tectonic activity the structure of the Variscian folded formations continued on to be complicated thanks to the further fracture formation and block shifts by fractures.As the result of this the Variscian folded area shows the more complicated structure than being at the moment of the Variscian folding final.

II. The Mesozoic platform mantel.

More than 80% of the investigated territory is closed by the Mesozoic- Cainozoic deposits mantel,among them dominate the Dat-Paleogene and Neogene. In the whole the mantel of the Mesozoic platform is subdivided into 3 complexes,being divided by the surfaces of unconformity and subjected to the dislocations to different degree.In the direction from the North to the South are exposed in general the more ancient members of this mantle;in some erosion windows appear the Triassic,Jurassic deposits and even is exposed the Paleozoic basement.

I. The Triassic and Jurassic folded complex.

The Vulcano- gene-terrigene strata of the middle and upper Triassic,terrigene coal--bearing of the Low -Upper Jurassic and Carbonaceous-Terrigene of the Upper Jurassic, as a rule outcrop by t e border of younger Mesozoic-Cainozoic formations ,or outcrop in the erosion windows in the Mesozoic platform mantel.
The nature of their occurrence is for example, by the left bank of the Surkhab river,to the North of village Doabi-Mekhzarin,shows that since the Triassic starts different stage of the development of the investigated territory.Actually,in the mentioned area distinctlyare seen the Triassic formations together with overlapping them by the Jurassic and then by the Cretaceous and Paleogene,occurring in one structural plan (flat plunge monoclinal to the NW) with sharp unconformity overlap the Paleozoic formations. The latter are crumpled into numerous small foldings.We can think that this fact is enough for relating the Triassic-Jurassic formations to the low stage of the Mesozoic platform mantel.

Howevers some facts and data- the formations of the Triassic and Jurassic and the nature of their dislocation, make us speak of some kind of condition of such relation or at any rate of the specifics of the Triassic-Jurassic strata in the quality of low member of platform mantel. Thus, the Triassic is composed,mainly, by the vulconogene formations(acid and middle lavas and their tuffs,reaching considerable thickness of more than 6000 m. This can be referred to the Irmalian and Mukradarin suites of middle and the Ishpushtian,Turmushian and Puli-Khumrian suites of the Upper Triassic.It is interesting to point out that the accumulation of the Triassic vulcanogene formations had no square distribution,being confined only to some centers of eruptions and zones, connected,apparently, with fractured faults.Vulcanic activity in the Middle-Upper Triassic was finished by very high intrusive activity at the border of the Triassic and Jurassic and by inconsiderable folding. The majority of the investigated massives of granitoids was impregnated at that definite time,outcropping among the Triassic as well as the Paleozoic formations.

The overlying Jurassic formations are represented by enicontinental coal-bearing--terrigene formations of the Low-Upper Jurassic.These strata have flysch-like nature and have definite rhythm in its structure.The Jurassic section is finished by gypso--bearing-Carbonaceous-Clayer strata of the Oxford-Titonian,having been accumulated under marine conditions only in one definite zone: uplifted articulation at the east of the Paleozoic massive and ovelapping the Paleozoic folded basement of the Mesozoic paltform mantel,but very deeply plunged in the west.This zone is traced from the latitude of city Puli-Khumri up to extreme ne part of the investigated area.Finally,at the end of the Jurassic period took place the impregnation of small intrusions,stocks, bed-like bodies and dikes of middle and basic composition.

The Triassic and Jurassic deposits are intensively dislocated in small foldings. In cases,when they are exposed in erosion windows among the higher horizons of the plat-

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form mantel,is seen distinctly innoncide of the structural plan of dislocated monotonously the Triassic-Jurassic deposits and the Cretaceous and the younger deposits, crumpled in different way,in general in larger,flatter and rounded structures. Thus, below and above the Triassic and Jurassic folded complex is singled out by the surfaces of the structural unconformity. Secondary unconformities are observed and inside this complex.The most distinctively is shown the unconformity between the Upper Triassic and the Low Jurassic. The confineness tot this border of poor folding of the Triassic deposits and active intrusion activity gives the foundation for dividing the Triassic-Jurassic complex at the Triassic and Jurassic structural stages.However in the area of the Shabashek coal deposit between the Cheldukhtaran suite of the Upper Triassic and the Regbulak Low Jurassic is not observed the interval and unconformity.This fact speaks again about the unic history pf the Triassic -Jurassic complex formation in general. For him is typical both simple foldings with middle and flat dippings of the beds at wings with length of3-6 km - for example, the Shabashek and Chekheldukhtaran anticlinals (7.8)-and smaller zigzag foldings (especially in competent Jurassic strata), often thrown back and tucked up,with the length up to several hundred meters (fig. 75). The same foldings are observed and in the Triassic deposits.

Thus, the described Triassic-Jurassic complex by its position and nature of the occurrence gravitates towards the platform area development stage.However its composition -in particular, the wide manifestation of magmatism in both vulcanogene and intrusive form- as well as the intensive dislocation are more typical for the folded platform basement.

T These incompatible features become understandable if to consider them from the point of position and development area peculiarities. Actualy,the crumpled into the foldings at the very end of the Paleozoic formations did not become fully consolidated to the beginning of the Mesozoic epoch. In this connection at the Triassic period the considered area reacted on the arising tensions in adjacent geosynclinal of the Beludzhistan-Gimalai by the formation of the fractures, eruptions by fractures of the mass of vulcanic rocks,occurrence of some separate rudimentary troughs.However the Paleozoic folding played the strengthening role and the tensions in adjacent area were not strong enough to bring to intensive and differentiated movements of the separate areas of the onvestigated territory,that is to say in another words- to restore here the geosynclinal regime at full volume.Vice versa,these phenomena played the role of the latter strenghthening the Paleozoic structure processes,after that starting from the Cretaceous period the whole area is represented as the whole.

That is why the Triassic and Jurassic formations are considered as peculiar folded complex. It is formed as the result of separate stages of the Early-Alpine (Cimmerian) folding,answers the transited (half-platform) stage of the development of the investigated area and composes the very low part of the mantel of the young Mesozoic platform. It should be pointed out that in more northern areas the Jurassic deposits also are considered to be the basement of the Platform mantel. However the Triassic deposits some people refer to the folded basement of the Mesozoic platform,preceeding from the intensiveness of their dislocation. (Bratash V.J. and others , 1964).

2. The Cretaceous-Paleogene dislocated complex.

Facies and thickness of the Cretaceous Paleogene deposits with the regular change of the transgressive formations by the regressive at the lengtho of the Low Cretaceous- - the Turkestan ,say that all this - normal platform deposits. However according to conditions of its occurrence they considerably differ from the usual platform mantel. Actualy, at the largest square of its development they are crumpled into flat, braccie-form foldings,roof-like up to several hundred meters-first kilometers and angles of the bed dipping at wings up to 10-30 ^{o} ,often assymetric.The folding mirrow is almost horizontal. Separate foldings are expressed distinctively and reach considerable hight, for example, convex-crown anticlinal near village Madr with diamiter up to 4 km. Its west wing to the low from the roof has the larger steepness,up to vertical and tucked up ocurrence in the low part of the slope,near thalveg river (fig. 76). The same foldings especially are typical for the fields of the development of thick and monotonous strata of the Dat-Paleogene limestones,for example, near the Shabashek coal deposit in interfluve Aokhorak- Camard-Saigan,near village Rui , etc. As the result of

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different competentness of the Dat-Paleogene and underlying Cretaceous formations very often can be observed disgarmonic folding, with more complicated foldings at the basement of the Cretaceous section. The latter, together with the underlying rocks, usualy outcrop in erosion windows among the Dat-Paleogene formations, often being confined to the washed out roofs of the case or flexture-like pre-fractured foldings. The example can be the erosion window near village Khodzhegan, where from gently dipping to the South (8-20°) the Dat-Paleocene limestones outcrops the Maastrikht, Cenoman-Turon and Triassic, sharply broken at the North by fracture, near which the Dat-Paleogene deposits possess steep up to vertical dippings to the North.

Very often can be come across among the fields of the Dat-Paleocene deposits the extented and flat monoclinals, representing the wings of the larger and flatter foldings. The example can be cuesta to the NW from village Nakhrin, with dipping of the Cretaceous deposits to the South with angles of 10-14°, monoclinals by both banks of the Surkhab river to the south of city Puli-Khumri, etc.

However the extented foldings, resembling by their type to usual lineal foldings, being formed in the folde area at the place of geosynclinal, are observed only along the fractured faults, mainly, near outcrops on the day surface of the Paleozoic folded formation. The same structures are described already by Grizbakh K.L. (1886) and G.G.Gaiden (1911). They are situated in the interfluve Saigan-Kamard. In the extreme south, along the left bank of the Saigan river is situated the anticlinal of the same name (1), to say correctly its preserved from the washout the northern wing. The dipping angles of composing it the Dat-Paleocene limestones reach 15-25° ; by places the monoclinal bedding ocurrence at the wings is complicated by pre-fractured foldings (fig. 77). The anticlinal is oriented to East-North-Eastern direction and stretches from the uppers of the Saigan river up to village Tala-Barfak, that is to say, at the distance of about 70 km. From the North the anticlinal Saigan is limited by the faults, by which it is conjugated with the Dashti-Safed anticlinal.(2). The latter is traced within the limits of the investigated s square at 45 km, reaching the width of 6-8 km. The folding also is formed mainly by the Dat-Paleocene deposits. Thank to fold bend undulation and considerable washout in some places under them are exposed the Maastrikht and Neocom-Aptian deposits. The anticlinal stretches to the East-North-Eastern direction. By the left bank of the Kamard river can be observed its closure, contoured by periclinal ocurrence of the Suzak deposits. The anticlinal is overturned to the south. The northern wing-is flat, with dipping angles of beds of 5-10° rare up to 32°, the southern-is broken, steep (75-80°), by places tucked up. As the result by places the Dashti-Safed anticlinal possesses the appearance of the lying folding, the head part of which is by flat or steep thrusts on the Suzak or Miocene deposits of the northern wing of the Saigan anticlinal. Parallal to the folding periclinal by the Dat-Suzak deposits stretches the border of the ocurring with the washout at the Suzak of the Miocene deposits which says about the formation of the folding at the post-Miocene time. To the North from the Dashti-Safed anticlinal sets off narrow Badzhgakh anticlinal (3). It also plunges to the NE and overturned to the South. The northern wing is more flat, the southern-is steep, by places overturned. (fig. 78).

Further to the North the described lineal stretched foldings are changed by braccie--form, cupola-like anticlinal and conjugated with them by troughs. Thus, to the North of the Badzhgakh anticlinal is situated isometric Madr trough (4) with tucked up northern wing composed by the Suzak and in the central part -by miocene deposits. Separate more or less stretched foldings appear and further to the North (for example, at latitudinal upper flow of the Askhorak river, by the Darrai-Terra, fig. 79, etc.), but only in connection with the fractured faults. Their lock parts usualy are strongly washedout and in the folding cores are exposed the Jurassic and Triassic deposits.

The certain stageness of the formation of the Cretaceous-Paleogene part of the platform mantel reflect the observed by the whole territory the surfaces of the washout between the Neocom-Aptian and Albian, between Kampansk and Maastrikht stages. That is why the Cretaceous-Paleogene complex is subdivided into three structural ~~stages~~ sub-stages: the low, the middle and the upper. They envelop respectively the Neocom-Aptian, Albian--Campian and Maastrikht-Turkestan stages. However the angle unconformities with these

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surfaces are not connected and the whole Cretaceous-Paleogene complex is dislocated uniformly.

The nature of the dislocations and also the absence of the differencesin structural plan between the Apt-Alb ot Maastrikht-Pre-Maastrikht Cretaceous formations make us think that the main folded faults of the Cretaceous and Tertiary deposits were oringed in the Oligocene an the Middle-Quaternary period,that is in main epochs of the folding comparatively closely situated of the Alpine Gimalai-Beludzhistan geosynclinal.

It is naturaly that the young dislocations complicated,overworked and covered the results of the more ancient dislocations. However one can suppose that at any rate the last two epochs of the tectonic activity (the Oligocene and Quaternary) possessed the equal aim,but complicating the existing flat structures(increasing the wing steepness, shove by fractures, etc. The folding of the Cretaceous and Tertiary deposits,situated on the rigid Paleozoic or to considerable degree the consolidated Jurassic and Triassic formations , has cover nature. The foldings were formed only in the Cretaceous and Tertiary deposits ,but the more ancient formations reacted upon the arising tensions apparently only by block shifts by the ancient or newly laying fractures.

3. Poorly faulted the Neogene-Quaternary complex.

The Cretaceous-Paleogene dislocated complex of the Mesozoic platform mantel changes by the Neogene-Quaternary deposits. The latter ocure with small unconformity both on the Cretaceous-Paleogene and on the more ancient formations of the Mesozoic platform mantel,or even of her folded basement. Such relations were caused by the Oligocene folding of the territory, which brought to the formation of the cover foldings in the platform mantel and ,apparently, to the block shifts in the folded basement.In its turn the Neogene-Quaternary complex may be subdivided into three structural sub-stages,divided by the surfaces of the washout and small angle unconformities. The low sub-stage is formed by the formations of the Shafai,Koshtangin and Madr suites of the upper Oligocene-Miocene and Miocene, Middle-Rustan suite of Pliocene and Pliocene-Low-Quaternary deposits and the Upper-Middle-Quaternary- recent deposits.The Neogene-Quaternary formations are observed in the western and central part of the territory,com composing small depressions and form the fields of the complete development in the North-East area.They form large and usualy isometric trough-like depressions and upliftings,often complicated by smaller and simple foldings with flat wings.The most wide distribution have the Rustan formations of the middle sub-stage.

In the North-west the Rustan deposits with interval,outwash and angle unconformity up to 10-20° occure on the Dat-Paleocene limestones.They form the flat braccie-like foldings of small sizes with angle dipping of beds up to 5-20°. Some tracing horizons form the flat undulated surface.

The Neogene deposits are mostly dislocated inthe North-East of the area,especially with c approaching to the Alpine foredeep,composed by the analogical formations,but of considerably big thickness (see below).

The dislocation degree in general is higher for the formations of the low sub-stage (Upper Oligocene-Miocene),becoming poor in the Rustan. However the folding nature (large bracci-like,flat) is the same.

Middle-Quaternary and younger deposits were not touched or were very slightly touched by dislocation. Nevertheless the investigated territory even at the Upper and modern epochs of the Quaternary period did not possess absolute tectonic tranquillity.It suffers slow rising movements,sometimes more stronger or more poor. About this fact speaks intensive outwashing of the mountain structures and accumulation of thick prolluvial deposits, the wide development of land-slide phenomena (especially in places of the distribution of loess-like loams at steep slopes) and etc.The formations of the upper sub-stage practically horizontally overlap the most ancient folded structures and also in the Neogene deposits.Dislocations of th the latter apparently took place at the Middle-Quaternary epoch,when there was the folding and mountain-formation in adjacent Alpine Gimalai geosynclinal.

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III & IY. Alpine folding areas.

The Alpine folded area envelops the North-Eastern part of the investigated territory,going into it by its extreme part. Respectively within the limits of the investigated territory is the extreme ancient mass (crumpled into the foldings by the Variscian folding) and foredeep.

The foredeep (III) borders the ancient extreme mass from the West,little by little pinching out to the South (to the North from village Nakhrin) and opening to the North.Its Eastern border-is sharp,coincides with the Ishkamysh extreme suture(I5). The latter represents fracture zones (steep and gentle thrusts) along which on the foredeep is thrusted the rigid Paleozoic mass.The foredeep mainly is filled by the fractured deposits of the Rustan Pliocene suite.They are crumpled into frequent steep foldings,especially,approaching to the east border of trough.Here can be observed the fractured faults with considerable shift amplitudes, up to several hundred meters. For example,one can observe tectonic contacts of the Shafai and Koshtangin suites,in some tectonical wedges among the Pliocene appear the outcrops of the Maastrikht deposits,etc. The dislocation of the Rustan deposits (up to 3-5 thou sand meters) increases to the North.In this direction also increases their thickness, reaching in some dozens km to the North from the investigated area about I0-I2 km. However the western and southern borders of the foredeep can be only conditioned, as in these directions diminishes the thickness and dislocation degree of the Neogene deposits,composing here the upper part of the Mesozoic platform mantel.

The extreme ancient mass (IY) is composed by the same crumpled into the foldings the Paleozoic formations,which also form the Variscian folded area.Here are also singled out the ancient Pre-Cambrian cores and solitary structural stages.However the Variscianf folded mass formations are considerably more intensive developed by the numerous fractured faults,are broken (further to the North-East)by the Tretiary Granitoids,thrusted together with the overlapping them the Triassic and Jurassic deposits on the foredeep of the Alpine folded area. The intensive crushing and small-block shiftings of the Variscian folded formations of this mass at the epoch of the Alpine tectogenesis is fully reflected in the structure of the sedimentary Paleozoid cover. The Vulcanogene - Terrigene Triassic and Jurassic strata,forming the more plastic mantel at the consolidated variscides,are crumpled into numerous overturned and sometimes lying foldings.They are cut by numerous fractured faults together with the Paleozoic socle.

Fractured faults.

All the considered formations are faulted by numerous fractured faults. In the West part of the area predominate the fractures of the North-Western,in the central -of the latitudinal and in the North-Eastern -of the North-Eastern strike. Thus, they are oriented in general parallal to the border of the outcropping to the surface of the Variscian folded formations. The fractured faults are very often crossed ,conditio ing the mozaic-small-block territory structure. Among them can be singled out the fractured faults of different age-having in view their occurrence time or at any rate, the time of the latter active shiftings by them - and genetic types.

The majority of the fractured faults envelop the Paleozoic,Cretaceous and Tretiary deposits up to the Pliocene.Thus, the age of the latter movements by them (having in view the possibility and the earlier ocurrence)- the Post-Pliocene,may by - the Middle-Quaternary when took place the second large (after the Oligocene) territory uplifting, the Mesozoic-Cainozoic mantel dislocations and mountain formation. This is approved by the fact that they never cross,but vice versa are overlapped by ash-talus deposits of the Upper-Quaternary age. However one can establish and more ancient fractures,connected,apparently, with the Oligocene epoch of tectonical activity. For example, by the North-Eastern wing of the Madr trough (4) on the Maastrikht-Suzak deposits by gentle thrust are moved the Vulcanogene Triassic formations.Many of the fractures,which were formed at the Paleogene or even at the Cretaceous periods conti-

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nued active existing and during next period.The shiftings by them took place in different directions.Thus,in I0 km to the North-West from village Dashi two longtitudinal fractures limit the sinking between Silur-Devonian in te East and the Low-Middle Paleozoic in the West narrow (up to I.5 km) stripe,composed by the overlapping the Low--Middle Paleozoic the Cenoman-Turon,Maastrikht and Dat-Paleocene deposits (fig. 80). As in close areas to the West and East the Cretaceous deposits are absent this stripe represents at the Post-Paleocene period the sinking block,that is graben,where are preserved the young deposits,washed out at the neighbouring areas. However the fracture which limits graben from the West sharply limits and the Rustan deposit distribution to the East,ocurring directly to the west from the graben an the Low-Middle Paleozoic. In limits of graben the Pliocene deposits are not included. For this there is only one explanation,that at the Post-Pliocene time and (Pre-Upper-Quaternary, because the fracture is crossed by the unfaulted ash-talus deposits of the Upper-Quaternary divisio the sinking before block by the same fractures-at least, the western,- underwent not the plunging but the uplifting.

Among the fractured fault are fixed different types: marginal suture, faults,steep and gentle nappes and often-complicated fractures with combined shifting in two directions.Vertical shifting amplitude by them reaches several hundred meters.

In some places (especially by the border of the Paleozoic folded formations and Mesozoic-Cainozoic platform mantel) the fractured faults echelon-like changing each-other form the wide fracture zones.Especially distinctly the latters are expressed in the North-East part of the investigated area and by the left bank of the Saigan river. Thus,by the both banks of the Farkhar river in the region of village Takaitumas--Dashti-Rubo is observed the overthrust by Ishkamysh madrigal suture (I5) of the Paleozoic formations together with the overlapping them by the Triassic and Jurassic deposits on the Rustan deposits. Frontal overthrust by the right side of the valley is steep: overthrust surface is plunged to the South-East under 70-80°. From the rear part joins some echelon-like branches,dividing distinctly the visible plates (2-3 km in length and up to I km in width) of the Jurassic and Maastrikht formations (fig.8I,82). In some packets,at the distance up to I km from overthrust front,between the Jurassic Maastrikht formations appear the Rustan deposits. In I0 km to the South-West ,by the left bank of the Farkhar river the overthrust surface is flatten out,becomes undulated-horizontal.Along it with 3-4 km shifting on the fractured deposits of the Shafai and Rustan suites composing the low parts of the slopes of the right banks of the Rudi-Namakab river and of the left banks of the Farkhar river are overthrusted the forming waterdivision the plastic gypsic and terrigene Jurassic strata. The whole head part of the overthrust (composed by the Jurassic formations)is divided by numerous fractures.Among them predominate fractures which are parallal to the overthrust front, rare normal and more rare - oblique.Is typical intensive dislocation of the Jurassic deposits,gathered into complicated and overturned -more often to the North-the foldings In connection with this latter phenomena in every part of the overthrust between the Rudi-Pal and Rudi-Namakab are observed the phenomena of salted tectonic (see below).

However further to the South-West the frontal overthrust which is the expression of the Ishkamysh marginal suture is not seen distinctively,because the wide space, especially in the limits of the extent Ishkamysh depression (I6), are closed by the Upper-Quaternary formations.Apparently, the Ishkamysh depression is neo-tectonical formation which was laid at the place of poor zone.In its limits can be observed only separate outcroppings of the Jurassic and Cretaceous deposits out of the Quaternary , apparently, broken by the feathering the frontal overthrust fractures (for example, by the North-West side of the Ishkamysh depression near Khazara Sai,Dzhar Tiba and others).

The Jshkamysh marginal suture is reobserved at the small area to the east from village Nakhrin where along the steep longitudinal fracture zone contact the Paleozoic (overlapped by the end by the Triassic and Jurassic) formations in the East and the Cretaceous - in the West.Thus, the total length of the Ishkamysh marginal suture is over than 80 km. Along the whole extent it distinctly singles out the uplifted socle

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(in the East) from the sinking (in the West) Variscian folded basement, overlapped by places by thick mantel of the Mesozoic-Cainozoic formations. However the shifting amplitude along him diminishes from the North to the South. At the latitude of Puli-Khumri and to the South in both sides from the extent fractured faults are exposed very often one and the same Paleozoic formations.

Apparently, by the fragments of this marginal fracture zone, already untracing to the South-West from village Nakhrin, are the oriented in the North-Eastern direction fractures in the uppers of the Sia-Darra-Kalagai river - the Kalagai fracture zone (13). Here one can observe flat overthrusts, in particular, the reminant of the tectonical cover by the right river bank, composed by strongly faulted and rugged Low-Paleozoic formations overthrust at the Dat-Paleocene or Maastrikht limestones. The reminant of the incorrect contour reaches 4 km in length, 300-800 m in width. The shifting surface is flat (20-30°) and gently plunges to the South-East; the shifting amplitude of the Paleozoic formations is more than I-I.5 km.

The continuation of the main fracture zone is the stretched in the North-Eastern direction fractures by the left bank of the Surkhab river starting to the west from village Dashi. They also form in general the wide enough Kalagai fracture zone, where can be observed both steep rectilineal faults and overthrusts and gentle overthrusts ((underthrusts ?). From this zone of the North-Eastern strike branch a number of wide fractures. They are traced at 20- 40 km to the West from Surkhab valley and condition the appearance of the outcroppings of the folded Paleozoic basement out of the Mesozoic-Cainozoic platform mantel.

There is one difference from the area of the Farkhar river. There, to the South-East from the fracture zone is outcropped high-uplifted Paleozoic mass and absolute shiftings and relative by Jshkamysh marginal suture took place in North-West direction, by the overthrust of the Paleozoic on the younger and plastic Mesozoic-Cainozoic strata, overlapping by the thick mantel deeply plunged the folded basement. Quite different position is observed by the left sides of the Surkab river and further by the Saigan river Here one can observe the gentle overthrusts, by which the relative shiftings took place from North-West to South-East or from the North to the South. Sometimes can be observed even imbricated structure with multiple appearance in tectonical beds of one and the same bands. Thus, in 6 km to the North-West from village Barfak at the Suzak deposits occure, being divided by gentle surfaces of overthrusts of the Barfak overthrust zone (I2 three packets (thickness is up to I00-200 m each), composed by the Suzak, or Dat-Paleocene and Suzak formations (fig.83) The same situation is observed and by the left bank of the Saigan river near village Khodzhagandzh, where under the thrusted Maastrikht-Paleocene strata in the Saigan thrust zones (II) are singled out three tectonical packets, composed respectively (downstairs) by the Miocene, Maastrikht, Miocene, thrusted on the Jurassic deposits. The youngest deposits in this area are the Miocene. Sometimes, the fractures limited the distribution of the Pliocene-Low-Quaternary deposits. Preceeding from all this we can suppose that here the main shiftings took place at the Post-Pliocene (Middle-Quaternary ?) period.

Special group is formed by close and or gaping joints- diaclases. They are observe in the form of dense net on the prepared surface of the Dat-Paleocene limestones (fig. 8). There are no shiftings by them or they amount only some meters. The length of the joints however can reach several km. It is typical that distinctly recognizing in the rigid strata of the Dat-Paleocene limestones, the such joints damp and are not traced in the overlapping them the Neogene depositsrepresenting in general uncompetent, more plastic strata (clay, conglomerates, sandstones).

Saline tectonics.

The phenomena of saline tectonics are observed in the North-East area of the forehead part of the overthrust between the Rudi-Chal and Rudi-Namakab rivers. In two places, in the cores of the overturned foldings occures gypsy-bearing-salt-bearing strata of the Kimmeridzh-Titon. As the result of the inten sive tensions arising during the thrust of rigid Paleozoic masses on the Neogene, and partially and of isostatic reasons salt and gyps are pinched out and penetrated the overlying deposits, composing

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the overturned folding wings. Such is the structure of saline cupola Namakab (Kan-Namakab cutted by steep and narrow Namakab valley and situated mainly, by its right side in steep meander. In spite of the fact that the cupola from the North-West and South-East is limited by the fractures and broken by them also it has izometric form in plan, reaching in diameter 2.5 km. On the periphery of the cupola are observed gypsis of thickness in some dozens meters. Bedded gyps interchanges with clay interbeds,intensively dislocated into serpentinised foldings. Rock salt is also bedded with separate interbeds dressed in clay. It is interesting that the beddiness is horizontal;May be it is already the secondary phenomene ,connected with izostatic overdistribution of the material during the formation of the saline stock. The visible its hight in river undermining reaches 200-250 m ,diameter is I km.

The second salt cupola is situated in I km to the North from village Chal in I3 km to the South-West from Namakab cupola. Salt-bearing - gypso-bearing deposits form the stretched to East-North-East direction body of 3 km in length, and width is up to I.5 km and jointed to him from the North-East the second stock,stretched to the North approximately at 2 km with width up to I.5 km. In the southern part the cupola is cut by dry sai. In the undermining of its right side one can see lenses-like body (with flat--undulated low and poor convex upper surfaces (rock salt reaching in the central part thickness of more than 40 m (fig. 85). From the above the galite lens is covered by clay-gypsy-bearing strata,reaching 40 m in thickness. In the West and North the described stock by the surfaces of the fractured faults is separated from the Koshtangin fractured deposits and Kellovian-Oxford limestones. The latters in the zone of tectonical contact are rugged. In the East part the salt stock is overlapped with the mantel of the Ash-Talus Quaternary deposits.The latters compose even areas and in the central part of the stock surface,which speaks of the fact that the formation was finished already to the Upper-Quaternary time.The surface of the North-East stock protrusion is mainly closed by the mantel of the Clay-Gyps-bearing deposits,reaching the thickness in several meters.

Thus, the considered conditions of the occurrence,folding nature, relations of the above described formations allow to speak about the following structural-tectonic zones within the limits of the investigated area (see tectonic map).

I.The Variscian folded area,underwent the Early-Alpine (Cimmerian) alteration in the South and the Alpine - in the North-East.

It forms narrow stripe along the South-East border of the investigated territory, separating from the overlapping it to the North the Mesozoic-Kainozoic platform mantel, mainly,by fracture zones. The Paleozoic basements are intensively dislocated composing the steep and pinched out foldings on the Northern wing of the Gindukush anti--clinorium. They are broken by numerous fractures,aquiring mozaic structure.In some erosion wiudows the folded and Paleozoic formations appear in the North of the area, where form the folded foundation of the Mesozoic platform.

The Kalendon folding in the limits of the investigated area was not shown; the Kalendon epoch represents incomplete stage of development of single Paleozoic geosynclinal.Could be observed only the most ancient (Pre-Cambrian)foldings,bringing to the formation of the ancient cores within the limits of variscides.

The Paleozoic folded structures were alternated by the Early-Alpine (Triassic, Jurassic) tectonic movements.

II. The Mesozoic platform. It is characterised by the wide development of the cover folding in the deposits,composing its mantel.Among them by degree of dislocation are singled out the Triassic-Jurassic,Cretaceous-Paleogene and Neogene-Quaternary complexes.

The accumulation of the Triassic and Jurassic deposits took place,apparently,in some troughs,laid in another structural plan on the Paleozoic folded structures.The laying of the troughs was companied by the fractureformation,thick eruptions of lava, block shifting of the basement,intensive intrusive activity at the Triassic and Jurassic border.Only during the Jurassic period are accumulated the Terrigene flysch-like strata

Originality of the formations,composing the Triassic and Jurassic as well as the "intermediated" degree of their dislocation allows to speak about the relic territory

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development at this time.The dislocated Triassic and Jurassic formations with the definite basement can be considered both as the upper stage of the folded foundation and a s the low understage of the platform mantel of the Mesozoic platform.

Cretaceous-Paleogene and Neogene-Quaternary complexes are composed by typical platform formations.They are also crumpled into cover foldings. The folding ~~touches~~ toughekes only the enumerated deposits,but their basement react on tectonic tensions by fractures and block shiftings along them.

III and IY. The Alpine folded area. It is included in the investigated area with its extreme part,enveloping the involved into the Alpine geosynclinal the area of the Variscian consolidation in the North-East area and limiting it from the West the Alpine extreme trough. The extreme trough little by little is pinched out to the South (to the North from village Nakhrin) and opens to the NOrth. It is composed by dislocated neogene deposits with thickness of more than 3-5 thousand meters. By fracture zones on it is overthrust the alternated by the Alpine movements the Variscian folded formation of the ancient marginal mass. The latter is formed by the Variscian folding and later was involved into the Alpine geosynclinal trough, and underwent in the process of the development of the Alpine geosynclinal the alternation. The latter was expressed in block shiftings, penetration by solitary plunged zones from the North of the Upper--Jurassic sea in appearance (beyond the limits of the investigated square) of the Tretiary intrusions.

YI. Chapter YI.

HISTORY OF GEOLOGICAL DEVELOPMENT.

The great part of the investigated territory is closed by thick mantel of the dislocated Mesozoic-Kainozoic deposits.More rare are met the Paleozoic formation outcroppings and only by Fulul and Rudi-Chal rivers are known conditionly the singled out Proterozoic formations.As the Paleozoic and Proterozoic (?) formations are outcropped only sporadically,it is difficult to make the full picture of the development of the investigated territory at the Pre-Mesozoic time. The study of the above mentioned formations (see chapter "Stratigraphy") allows to consider only the main stages of the geological history of the area.

The Proterozoic formations are represented by methamorphic rocks: Gneisses, Amphibolites and Cristallic schists. They underwent the considerable methamorphism--apparently, regional-under conditions of high temperatures of Almandine-Amphibole facies.The sharp difference of methamorphism of the Proterozoic ?) formations in comparison with the low and middle-Paleozoic says of considerability and intensivity of the Pre-Paleozoic tectonic movements. It is difficult to say definitly concerning the origin of the rocks,which are turned into Crystallic schists and gneisses.However, it is more unlikely that in any case the accumulation of their thick strata(Visible thickness is more than I500 m) took place under geosynclinal conditions. Apparently, took place intrusive activity: very often one can meet in pebbles of the overlying Siadarin deposits the Granitoides.

The following stage of the development of the investigated area,being separated from the preceeding by considerable interval and folding-is fixed by the deposit formation of the Siadarian suite,which envelops,mainly, the Ordovik period. These deposits often are met in separate outcroppings: in the Surkhab basin river from village Doabi-Mekhzarin up to village Kelogai, and in the North-East of the area by the right tributaries of the Rudi-Chal river,reaching 2-3 thousand meters of thickness. The accumulation of the sediments of the Saidarian suite took place in some disconnected troughs. Under conditions of the sea regime was laid clay material,sometimes changed by the sand one.To the end of this stage of sediment accumulation in the northern trough took place the underwater jointed eruptions of lava of main and acid composition Then the rate of warping diminished, and the southern trough,apparently, was dried. Close in their composition the methamorphic formations,belonging to methamorphic facies of green schists and Almandine-amphibolites are developed near city Puli-Khumri.

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Apparently, the accumulation of these deposits (unrugged Low-Middle Paleozoic) took place during the longer period than the deposits of the Siadarin suite.

The Silur and Devon are represented by the Durumbak suite with thickness of up to 3000 m,developed where the Siadarin is situated. The accumulation of the sediments at that time continued in slowly plunging sea basin. Only in the Southern part of the area before the Durumbak deposit accumulation was observed the short period uplifting,washout, and ,may be, poor folding.The latter supposition is conditioned because the degree of methamorphism of the Low-MiddlePaleozoic deposits and the Siadarin suite in general a little higher than in the overlapping the Durumbak and Tundarin suites. In the Silur--Devonian sea,mainly, took place the Carbonaceous sedimentation.Only by time the accumulation of the limestones altered by sedimentation of sand-clay material. At the first stage of sedimentation (may be in Silur) in the central part of the area took place the underwater eruptions of lava of acid and middle composition,and in the South part of the basin- short period and local upliftings of separate areas,turned into the islands with the accumulation near them the interbeds of inner-formation conglomerates. Only at the end of the Devon takes place the alternation of sedimentation accumulation conditions. In the Upper Devon and Turneian Age in the central part of the investigated area under sea conditions continued the accumulation of the sediments in the Tundarin suite,reaching thickness of 2500 m in trough of the latitudinal ~~sit~~ extention.The bottom of this trough was movable enough. Were not stopped the jointed eruptions of acid and middle lava ,and sometimes of more basic (interbeds of serpentinites); limestones and fractured rocks were accumulated in sharply subordinated volume. The vulcanogenic activity little by little was finished only at the end of the Turnei Age. In the North-East of the area at this time are acuumulated ,mainly, the Carbonaceous and fractured rocks; the less role play the Vulcanogene formations with more basic composition (amphibolites,serpentinites(), than in the central part of the area.

During the Carbonaceous period ~~mf~~ the accumulation of the sediments continues on, apparently, at the considerable part of the investigated territory. Among the Carbonaceous formations by the left side of the Surkhab river were fixed the outcroppings of the Vizeian deposits, here also-the deposits of the Kalaimurat suite of the Middle-Upper Carbonaceous and Unrugged deposits of the Carbonaceous (Farkhar suite) in the North--East area.

The Vizeian accumulatiou deposits - known by the left side of the Surkhab river from village Doabi-Mekhzarin up to the Kalai-Murat river, - was after the total uplifting of the whole territory and the deposit outwash, and the Upper-Devon -Turnei deposits. Took place and poor tectonic movements,methamorphising all the most ancient deposits from the Low Paleozoic up to the Upper Devon- Turne. In another way took place the formation of the Vizeian deposits in the South and North parts of the investigated territory. In the South,in undeep sea basin which underwent the constant vibrations of its own level, accumulated ,basically, the clay and thin-fractured sediments with thickness of 450 m. The short period of the relative uplifting or pinching out of the basin were fixed by the appearance of sandstone interbeds,conglomerates or limestones. In the North part of the area for the Vizeian stage are typical only limestones,deposited in the warm and shallow sea basin,which underwent the slow and regular pinching out. It is unlikely that the two both areas of the formation of the Vizeian period sediments are the parts- marginal and central - of one and the same sea basin.

At the end of the Vezeian Age took place considerable in comparison with the previoustectonic movements as the result of which the Vizeian and underlying them deposits were crumpled into the foldings and underwent the regional methamorphism. Then, after the period of uplifting and washout began to accumulate the deposits of the Kalai--Murat suite of the Middle-Upper Carbonaceous with thickness up to 2500 m. The formation of the sediments of the Kalai-Murat suite took place in shallow sea basin,besides first of all were deposited the clay sediments and then the sandy ones. The analogical composition have unrugged Carbonaceous deposits (Farkhar suite) in the North-East part of the area,composed mainly by sands and clay schists,rare - by aleurolites and limestones. Apparently,their accumulation took place in the same shallow sea basin. It was finished by the intensive folding of all deposits. Apparently, to this folding belongs the

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intrusion of the Carbonaceous intrusive complex represented by diorites,granites and granitoides,dikes and gabbro stocks,diabase and spessartite. Actually, in the investigated area was established that they break the deposits of the Durumbak suite of the Silur-Devon and transgressively are overlapped by the deposits of the Upper Carbonaceous- the Low Permian. In such case they represent sinorogene formations of the Variscian folding epoch.

The following time interval,characterised by the preserved in the North-East and by the Surkhab river deposits, envelops the Carbonaceous end and the Permian beginning. The sandstones and aleurolites with interbeds of limestones and conglomerates with unconformity occure at the Proterozoic (?) formations ,reaching thickness of 1100 m . Their formation started after the folding,uplifting and territory washout under conditions of warm and shallow sea basin,occupying large squares and beyond the limits of the investigated territory. About this speaks the closeness of the discovered in the described deposits the known Fuzulinide complexes in the Ural and Tyan - Shan.

The formation of the sediments in this basin continued on during the Sakmar and Artinian Ages. At that time deposited limestones,as well as clay and small-fractured rock ,rare conglomerates.The Sakmar-Artian deposits known by the left banks of the Surkhab river between village Doabi-Mekhzarin and Dashi, crown the Paleozoic section in the investigated area. However , directly to the South , are known the outcroppings of the upper-Permian limestones,containing numerous fuzulinides, That is why it is possible to suppose that the shallow and warm sea existed at the certain part of the investigated area at least and during the part of the Upper-Permian period.The intensity of folding of the Upper-Carbonaceous- Low-Permian formations (considerably more than the Middle-Triassic and more young strata) allows to say that at the end of the Permian or at the beginning of the Triassic took place the considerable folding ~~first~~ stage, which finished the development of the Paleozoic geosynclinal. As the result of this folding were dislocated the deposits of the Upper Carbonaceous-Low Permian,underwent the complication already existing foldings in more ancient Paleozoic deposits. Then took place the general uplifting of the territory and retreat of the sea, started the process of outwashing of the Variscian folded structures.

At the Low-Triassic period the investigated area pas preserved mainly as land. The deposits of this Age are not known here. Only at the Middle-Triassic period the part of the southern half of the area is enveloped ,apparently, by the sea gulf of sub-latitudinal strike,closed to the East and open to the West. This area underwent the intensive pinching out,within its limits took place the thick underwater eruptions of lava of middle (Porphyrites of the Irmalic suite),and then of acid composition (Shucradaric suite),reaching thickness of more than 4700 m. At the second period of the accumulation of the vulcanogene strata,especially in the beginning,took place local upliftings,which brought by places to the accumulation of shallow facies with braccie-lik fauna and vegetation detritus. During the Karni and Nori Ages the accumulation of the sediments took place appoximately within the limits of the same epicontinental sea basir The fractured deposits were accumulated under conditions of the shallow sea with its pulsion pinching out. The section often has the flysch -like nature,reaching thickness of 1000-2000m,Vulcanic activity at this time practically is not shown,though in a number of places are met the little-thick covers of the Andezite lavas. However,vulcanism, by places sharply is shown in Reet Age. Basically, the vulcanogene rocks form the Ishpushtin and Turmush suites (lavas,Tuffs-lavas, tuffs-breccies of the Avgite Andezite, Quartz Porphyrite and Quartz Porphyre,which are cut by dikes and stocks of the basic composition reaching thickness of 1300 m. They are developed at small areas. In other places the Reet stage is represented by the fractured strata with considerable participation of the Tuff-Gene rocks (the Puli-Khumri suite,thickness is more than 300 m).The accumulation of the Reet deposits took place under continental conditions,in separate erosion-tectonic depressions. Finally,by places the Reet deposits are represented by the deposits,accumulated under delta conditions (the Cheldukhtaran suite with thickness of more than 1500 m).

At the end of the Triassic the accumulation of the described formations was finished with the folding,but not very intensive.The folding was shown not by all places. Thus, at that time the most intensive activity is shown,takes place the intrusion of the large intrusive diorite and granodiorite bodies.

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At the Jurassic period the accumulation of the sediments took place under continental conditions. They were deposited in separate intermountain depressions, in the alluvial,lake or swamp surroundings. About this speaks the quick facial deposit alteration,often bed pinches out, splitting of the Carbonaceous beds.

By places in the North-East part of the area among the Terrigene-Fractured deposits of the Low Jurassic with the Carbonaceous interbeds are present the Vulcanogene rocks. The total thickness of the Low-Jurassic deposits is about 500 m. At the Middle- Jurassic period the analogical terrigene-fractured coal-bearing deposits,reaching the thickness of 800 m, were accumulated at separate troughs. For example, in the areas of the Shabashek, Sary-Assii,Lela,Karkara and Nakhrin. They continue deposit in intermountain depressions, filled with river,prolluvial,lake or swamp deposits,often being formed under conditions of periodically swamped deltas. The total square of such intermountain depressions reached the first thousand km^2 . At the Upper-Jurassic period the accumulation of the sediments went on in the biggest part of the existing intermountain depressions,being filled with alluvial-prolluvial formations with thickness up to 500 m. Only in the North--East of the area,in the narrow stripe from city Puli-Khumri up to the Farkhar river the analogical terrigene deposits,accumulated firstly either under the same conditions or under shore-sea little by little changes by sea terrigene-fractured and Carbonaceous formations,reaching thickness of I500 m. It is interesting to point out that the crowning in this stripe the cut of the Jurassic the Kimmeridge-Titon deposits are represented by regressive facies of red-coloured gyps-bearing terrigene formations.

As the Triassic and Jurassic periods are the important stage of the accumulation of the Carbonaceous within the limits of the investigated territory, the paleographic situation of this time is illustrated ~~together with~~ by a number of lythologo-facial scheme (see fig. 86- 94)

At the border of the Upper Jurassic and Low Cretaceous were observed the Early --Alpine (Cimmerian) tectonic movements. They finished intermediate development regime of the investigated territory,which changed in the Triassic period the geosynclinal area development into the Paleozoic epoch.With the beginning of the Low-Cretaceous period begins the new platform development stage of the investigated area,which has in its turn specific features.

The above mentioned Late-Jurassic movements were relatively poor. They crumpled plastic enough terrigene Jurassic deposits into comparatively flat and izometric foldings,not having lineal extention. Apparently, these movements were continued by the intrusion of the complex of small intrusions.The latter break Cellovei deposits and are not met among the Cretaceous and more young formations. They are represented by diabases,intrusive spilites,andezites and andezite- bazalt,forming dikes,bedded bodies and small stocks. After this took place the uplifting,denudation and at the beginning of the low Cretaceous --slow plunging of the territory.Sedimentation was carried out under conditions of water surrounding,in lake,river basins and shore areas of shallow sea. Apparently, from the beginning the accumulation of the sediments took place irregularly; their thicknesses rapidly changed at inconsiderable distances,depending first of all from the nature of the area relief.The area of the accumulation of the Low-Cretaceous deposits enveloped the big part,but not the whole territory.Sedimentation took place in the South-East part of the area,to the South from the line,stretched out in the North-East direction and which coincides in its southern part (from village Doabi-Mekhzarin up to village Dashi) with the Surkhab river flow and passing to the North across village Nakhrin--Ishkamysh-Farkhar. However to the North from this line the sediments deposited not at the whole territory,but in numerous depressions,which are divided by numerous upliftings ,delivering the fracture material. There are some cases of the accumulation of the Low--Cretaceous deposits and to the South from the mentioned line. However,their thickness does not exceed the first dozens meters,and development fields are limited enough (for example, the area of the uppers of Piez-Kul-Larkhab saia).

Poor movements at the end of the Apt Age brought to the general uplifting of the whole territory, both its South-East and North-West parts.Only at the small border area stretched out in the North-East direction from city Puli-Khumri up to village Nakhrin, after short period lifting and inconsiderable outwashing,which is fixed by stratigraphic

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unconformity between apt and alb, the accumulation of the sediments went on practically without interval from Alb to Kampan Age. The sediments depositedin a bay of shallow and warm sea basin. Here was brought the small fractured and clay material and took place the accumulation of sandstones,aleurolites,clay and limestones. At the end of the Alb took place the variation of sea level,frequent regressions , as the result of which among clay strata appeared the gypsum interbeds.

However to the West from this stripe during the Alb-Kampan the picture was quite different. The interval as the result of the lifting territory after the accumulation of red-coloured deposits of the Low Cretaceous was considerable and the area was enveloped by the sea only in the Cenoman or even Turon Age. At that time began to be accumulated the Terrigene,clay and Carbonaceous sediments. Then,during the large part of the Senon time the area again represented land,which was undergone denudation. It is very difficult to say this for sure,because in the North-West areas at the Cenoma Turon deposits with washout occure the Maastrikht.

The Maastrikht transgression represents the main stage in geological history of the Cretaceous period of the whole North Afghanistan. It envelops the area by the left side of the Surkhab river and the right side to the North,limited from the South-East by the same line that the area of distribution of redOcoloured deposits of the Low Cretaceous. Always the Maastrikht deposits occure with large washout and in places, where they are underlyied by the Pre-Cretaceous formations- and with angle unconformitie Less distinctly the unconformity in the basement of the Maastrikht is expressed in the stripe of Puli-Khumri - Nakhrin,but here also one can point out this in the form of stratigraphical interval. In the Maastrikht sea were accumulated sandstones,clays,organo gene-fractured limestones. The basin remained warm and shallow.About this speaks the constant admixture of aleurolite and sandstone material at the Carbonaceous rocks,the presence of interbeds of fractured rocks. During the Maastrikht Age many times took place unconsiderable variations of sea level, shallowing of some its areas, isolation of some lagoons,where accumulated dolomites and gypsum,changing by small plunging and new accumulation of limestone strata. The most stable regime of this basin aquires from the Datchan Age.

In the Dat Age- Paleocene as well accumulate almost the Carbonaceous sediments, depositing within the limits of the whole North-West part of the territory. About the wide distribution of the sea and considerable denudation degree of the surrounding areas speaks practically full absence of the Terrigene admixture in limestones. The sedimentatization continues on under such conditions and in the Eocene. However the sea little by little shallows and retreat to the North. Actually, the deposits of the Suzak stage are distributed more widely than the Alai or Turkestan and go up to the southern border of the distribution in the investigated area of the Mesozoic-Kainozoic d posits.For example, they are still met by the left shore of the Saigan river. The Alai and Turkestan formations form only small outsroppings in the North-East part of the territory.

Thus, since the Cretaceous period and up to the end of the Eocene,being fractured b inconsiderable movements at the end of the Apt and Maastrikht Age, takes place the deposit of normal transgressive-regressive complex of sediments with total thickness of up to 2700 m. The sediments are represented by only platform formations : the Terrigene,Clay and Carbonaceous. There are no traces of vulcanic activity.

In the Oligocene takes place intensive enough and rapid uplifting of the whole territory,accompaning by the laying and resuming of the numerous fractured faults, especially in the regions of direct outcrop at the day surface of the consolidated Paleozoic form ations,by the cover folding of the Mesozoic-Kainozoic mantel, mountain formation. Only at the end of the Oligocene (?) Miocene the eroded to some extent surface becomes the arena of sedimentation. Sometimes, for example,at the beginning of the deposit accumulation of the Madr suite of the Miocene- locally and very poor is shown the vulcanic activity (the eruption of main composition lavas).More actively and synchronically with slow uplifting of the territory takes place the accumulation of thick fractur strata in the Pliocene.

The thickness of the fracture strata of the Neogene is different. It especially increases in the North-East part of the investigated area. This circumstance and the

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trough fact of the Paleozoic folded formations together with the overlapping them little-thick mantel of the Triassic and Jurassic deposits on the Tretiary formations are connected with the laying the foredeep in the Alp Neogene. The marginal trough is closed,little by little narrowing to the South to the North from village Nakhrin and opens to the North,traced at the territory of the USSR.

At the beginning of the Quaternary period (especially intensive,apparently, at the Middle-Quaternary epoch) takes place the lifting of the territory,mountain formation, the formation of modern relief forms and the laying of modern river net. The further movements (mainly, the lifting) the area undergoes and at the end of the Quaternary period,about which speak overdeeped river valleys, suspended valleys of side tributaries different hights,at which one can find the surfaces of levelling and are situated the loess covers of the Upper- Quaternary division, etc. About the modern mass shiftings speak the high seismic activity of the Afghan territory.

As the tectonic movements of the Quaternary period played have the important role in formation of modern oblique of the territory,more in detail they are considered in chapter " Geomorphology ".

Chapter YII.

G E O M O R P H O L O G Y

The concerning territory envelops the areas of different geomorphological structur By the main relief-forming factors here can be singled out three types of the relief : erosion-tectonic (type A); structural- denudational (type B) and denudation-accumulative (type C). The difference in relief-formation at separate squares of the investigated territory are explained first of all by the position at the junction of the Mesozoic platform and folded Paleozoic mass (fig. 95). The latter represents tectonically relative high protrusion,contouring the platform area from the North East. At the Neogene and Quaternary period this protrusion intensively was undergone by erosion process,which brought tothe formation here of the erosion-tectonical middle mountain relief (subtype A I). The squares which envelop the area of the platform in the North-East and in the West of the investigated territory had somewhat different tectonic history. This certainly influenced the process of relief formation. Thus, in the North--East approximately up to meridiane Puli-Khumri,in the Neogene distinctly were shown the falling movements,which brought to the laying of marginal trough and the accumulation in it the molassa-like roughly-Terrigene strata of the Rustak suite,where during the following lifting of this area was formed erosion-tectonic low-mountain relief with comparatively small depthof cuts (subtype A 2). Here ,at the next time develop the applicated Quaternary depressions,accumulating the modern deposits (Ishkamysh,Puli--Khumri and other depressions),which are characterised by the development of the denudation-accumulative relief forms (subtype C I).

In t e West ,during the same Neogene the plunging of the platform was relatively inconsiderable. The soft deposits of the Rustak suite here are accumulated in the form of small cover,which in the following lifting of this territory was completely removed by the denudation processes,which outcropped the structural surface,composed by the Dat-Paleocene massive limestones. In the zone of marginal part of the platform,thank to great activity of tectonic processes this structural surface was pinched out into the foldings compoundly and was faulted by the fractures,which brougnt in some cases to the formation of questa forms of relief. Thus, here was formed the structural-denudation middle-mountain relief (subtype Bi).

In this area the erosion processes at separate areas thank to the gentle anticlinal bulges were shown more intensively,as the result of which the structural surface was broken completely and among the structural-denudation type relief were shown "windows" of erosion--tectonical middle-mountain relief,analogical to the developed in other areas of the territory concerned.

Thus , the investigated territory can be subdivided into four large areas,well visible at the geomorphological map and shown at the attached scheme of geomorphological zonation (fig. 95).

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Below is given the description of types,subtypes, variaties and forms of the relief,featured for each area and are given some considerations concerning the ways and time of their formation.

Erosion-tectonic relief type on the investigated territory is the most widespread. It occupies more than 2/3 of square (78%),enveloping ,mainly,all north-eastern half and partially the areas which are attached to the basin of the middle flow of the Surkhab river. The erosion-tectonic development relief is conditioned by the above mentioned rising differentiated tectonic movements,forming the conditions for showing the processes of erosion separation.

Erosion-tectonic type of relief by its high position and nature of the separation is divided into two subtypes; AI-middle mountain relief with absolute hights from I200 up to I400 m and with depth of the cuts of river valleys up to 800 m and A2 - low mountain relief with absolute hights from 600 yp to 2500 m and with depth of the cuts of river valleys at average up to 300 m.

The middle mountain relief occupies about 35% of the investigated territory,enveloppingm , mainly, the South-East and to some extent the Central-Southern areas. He is developped ~~xxxxxxxxxxxx~~ at the most tectonically uplifted areas ,which have considerable energy.

Middle-mountain ~~xxxxxxxxxxxx~~ relief by character of the separation,depthes of the cuts,character of slopes and tops are subdivided into three types:

a) steep sloped ,separated in large parts;
b b) steep sloped ,separated in middle parts;
c c) steep sloped ,separated in small parts.

The steep sloped ,separated in large parts relief (fig. 96) is observed in the North-East part of the territory,as well as in the central parts of the situated along the Southern border of the investigated territory. The described relief is developed at the areas,composed mainly by intensively dislocated and methamofphised to different degree rocks of the Paleozoic,Pre-Cambrian and Granitoides.The squares of the development of this kind of relief differm by the most considerable absolute marks,reaching 4000 m and by the deep cuts of the river valleys-up to I800 m. The slopes are differed in steepness and rockness with numerous gravitate pebble accumulations,especially frequent in their basement. In majority of cases the the valley slopes are convex,from their bottoms one can not see tops and waterdivision ringes. The latter often raise by steep cliffs,ro rock or have sharp and crest-like form.

The valley bottoms usualy narrow,not exceeding in width of 200-300 m,rare reach 500 m. They represent sloped to bed of the river the areas of low complex of erosion--accumulative terraces (hight is up to I2 m),stretching along the bed not more than at 0.2-0.5 km and overlapped near slopes by the pile of the gravitated accumulations.

The described relief has no icy (Alpine) forms (troughs, corries, etc.) as well as relictic forms of ancient relief (for example, levelled surfaces,etc.).This is explained by intensity of tectonic uplifting and great velocity of erosion processes, which altered all the before formed elements of ancient relief, and the icy also.

Lythological difference in composition of rocks are reflected at relief formation very slightly. At the rocks of different composition and different degree of methamorphism (from phillites up to cristallic schists)are mined only reliefs of one type. A small difference can be pointed out in areas of wide development of granitoids (for example, the central part of the investigated area,where the relief forms differ by less slope steepness by smaller quantity of rock outcrops,by not such sharp waterdivision etc.

In connection with this in the described relief one can single out two subtypes:

AIa^{I} -relief mined on Granitoides and
AIa^{II} - relief,mined on sedimentary and methamorphic rocks.

The steep sloped middle-separated relief (fig 97) usualy contours the areas of the development of the large-separated relief and rare is developed beyond dependence on it, for example, in the Shabashek and Dakhanitora,in the uppers of the Surkhab river and other places. This kind of relief is mined usualy on the relatively slightly methamorphised rocks: phillites, effusives,interbedded argillites,aleurolites and sandstones,etc.

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The squares of the development of steepsloped middle-separated relief is different by by relatively small maximum absolute marks,reaching 3000 m and by comparatively less depth o of river valley cuts -up to 800 m ,rare up to I000 m. The slopes differ in more gentle forms.Though one can see often rock outcrops,but they are usualy separated by pebble gravita ted accumulations,often semi-fastened,especially in the basement of the slopes. The water divisions are usualy smoothed,covered by pebble-loam elluvial-talus accumulations, very rare steep and rock. The slopes of the valleys are flat, from their bottoms one can see water--divisions very well.

The valley bottoms are usualy relatively wide,reaching in width 0.5-I.0 km. The terrace complex is fuller and more persistent: besides the terraces of low complex are present the terraces of middle hight - up to 80 m and as an exception are preserved the benches of I80-200 m of hight. The distinctive feature of this relief is the presenne of the preserved single glacial forms of relief in the form of " shoulder-bladers "of ancient troughs and corries with preserved strongle broken moraine,usualy at the absolute marks of from 2500 up to 3000 m and rare riegels.Apparently, the less energy of this type of the relieff favoured to partial preservation of ancient forms.

The described type of relief practically is not subjected to lythological control. May be there are some exceptions represented by limestones and marbles,which form sometimes rocky erosion scarps,but in the whole they don't represent the forms typical for the described relief.

The steep-sloped small-dissected relief (fig.98) is limited in distribution. It is developped by the left side of the Surkhab river , in interval of Tala-Canos.This relief is developed on the slightly methamorphised rocks of coloured composition: effusives,sandstones, limestones,argillites,phillites,etc.The area of this relief has maximum absolute marks up to 2400 m in depth and the depth of valley cuts is up to 600,rare up to 800 m. Drain net is different by the density and complication of branching.The valley slopes are steep ,small rocked with widely developed small rock waste,usualy unfixed taluses.The water divisions are sharp-topped,often ridge-like,rocky.

The valleys xxx usualy have steep dippings and differ either by the absence of terraces or by the presence of the first above the flood plane terrace,of I2-I5 m in hight,which is overlapped near sides by gavitated small rock waste accumulations.

This relief bythedissectionxhxxxtexxxxxmbinxthexxtiefxnf has specific features, mainly,thanks to the development here of numerous small valleys,which steeply fall to the Surkhab river - local erosion basis.

The considered above three types of erosion-tectonic middle-mountain relief in general, are notable for high energy. Tectonic movements ,shown at the Post-Neogene time(in the first half of the Low-Quaternary epoch) , brought to general uplifting of the territory. However, the fact that the lifting had sharp differentiated character is explained by the relief formation. The Paleozoic Variscian mass to which mainly are confined the above described types of the erosion-tectonic relief was lifted and ,apparently, overthrust at theMesozoic platform by the Ishkamysh marginal suture. This caused the large kmickpoint of altitudes, which was adopted in the North-East area,foe example, by the difference between the recent absolute marks of the Ishkamysh depression of II00 m and mountain ridges,situated to the South-East from it (4400 m)This difference amounts 3300 m at the distance of 6-7 km.

In the central part of the investigated territory was also the area of the Mesozoic pla form with altitude above sea level of more than 4 thousand m. However here the Surkhab river made the knickpoint of altitudes between it and the tops,which are situated to the North-West from ridges at more than in 2800 m.(the area between village Tala and the Caion valley).This difference of altitudes made conditions for intensive showing of erosion of sharp dissection of this part of the investigated territory.

The time of the formation of the described erosion-tectonic middle-mountain relief belongs to the period since the Low-Quaternary epoch up to present time.

At the present time in the areas of development of middle-mountain erosion-tectonic relief the erosion processes are very slow because of the lack of humidification of climate. In small and middle valleys often can be observed the mass of gravitation-talus and prollu-

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vial accumulations,which because of low-watered rivers remain in channels. Only large channels, such asFarkhar, Chal (Tangi),Surkhab ,etc continue to deepen their beds. As the result of this the side valleys often has the suspended character,mentioned either by the mouth bar,or by sharp knickpoint in the bed gradient.

The lowmountain subtype of relief is developed mainly in the North-East part of the investigated territory and occupies about 30% of the whole investigated territory. It envelopes the stripe about 35-40 km,contouring from the North-West area of the development of the early described middle-mountain relief. This subtype of relief is developed on the tectonic relatively sinking part of the territory,which envelops the marginal part of the Mesozoic platform.Separate small areas of this relief are mentioned in the West also along northern border of the area,though fot these areas it is not typical.

The low-mountain relief by the character dissection,cut depth,nature of slopes and waterdivision space is subdivided into four types of relief;

a) steep-sloped hilly;
b) steep-sloped large-ridged;
c) steep-sloped small-ridged;
d) steep-sloped small-dissected;

The steep-sloped hilly type of relief (fig. 99)has the limited distribution and, mainly,is developed in the North-East part of the area,where occupies the intermediate position between middle-mountain and low-mountain types of relief. Its small spots can be observed as well in the North-West,for example,in low flow of the Nakhrin and Shoraw rivers as well as in the South-West, in the intermediate of the Saigan and Surkhab rivers.

The squares of development of this type of relief are chatacterised by different absolute altitudes from 1000 up to 2800 m above sea level and by comparatively small depths of valley cuts,reaching not more than 300 m. The slopes are usualy gentle,slightly convex or flat, covered with turf,with rare small rocky outcrops.The tops are rounded to flattened

The formation of this type of relief is influenced by lythological composition of rocks. In connection with this are singled out two subtypes:

$A2a^{I}$- relief,formed on the slightly dislocated clayey and sand-conglomerate rocks

$A2a^{II}$ -relief,formed on the slightly methamorphised limestones and marls,as well as on the more methamorphised fillite and aleurolite schists.

From these two subtypes of relief,the second (AIa^{II})- is notable for bigger steepness of slope and for many rocky outcropps to the slopes.

The described type of relief was formed under conditions of moderate energy of relief formation and during the long intervalof time. The altitude knickpoint at the squares of development of this relief usualy does not exceed 500 m, in average it amounts 300 m .

Time interval of this relief formation is the middle of the Upper-Quaternary epoch up to present time. This is approved by the fact that loesses,which formation time is determined as the beginning of the Upper-Quaternary period, participate passively in the process of this relief formation,and preserving itself only in the form of remnants on the tops of separate slopes.

The steep-sloped ranged relief (fig. 100) has comparatively wide distribution, Besides the North-Eastern part of the investigated territory in the form of separate areas it is widely distributed and in the West part of the territory.

The altitude position of this type of relief at present time envelopes still more wide diapozon and ranges from 600 up to 3000 m above sea level. The depth of valley cuts usualy does not exceed 150 m . This type of relief is closely connected with the process of the formation of loess rocks,which at the beginning of the Upper-Quaternary epoch covered the whole investigated territory. The following tectonic movements of aleirogenic character, which were shown in the middle or end of the Upper-Quaternary period,brought to the general uplifting of the territory and its inclination in general to the North. Water floods,appearing at this plane, little by little began to work out the valleys of subparallel direction in loesses ,which formed the described type of relief.

Depending on the altitude position of the areas and steep ness of inclination of the first loess plain,the valley cuts took place with different intensivity and speed. The loess cover in a number of cases was broken by them, and the valleys epigenetically went on

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to be cutted in the underlying rocks. In this case the loesses were preserved only at the waterdivisions as " covers ". When the valleys deepened and the denudation of slopes,the loesses appeared to be washed out completely and the valleys,as the typical epigenetic,went on to be worked out in underlying neogene or more ancient rigid rocks (limestones,garnets,etc.,),often cpmpletely being undependent on their tectonic structure (fig. I02).Taking into account allthis the described relief is subdivided at three independent subtypes,each of which has its distinctive features:

$A2b^{I}$ - relief,worked out on the flat or horizontally lyed clayey-sandy-conglomerate rocks,which are covered with loesses or on loesses and loess-like loams;

$A2b^{II}$ - relief worked out on the slightly dislocated neogene-Quaternary rocks, covered with loesses and underlying dense rocks (limestones,garnets,etc) The soft rock were preserved only in the form of " covers ".

$A2b^{III}$ - relief worked out on limestones,garnets, dense rocks and which is epigen tic; the soft cover is completely eroded.

The distinctive features of these three subtypes are in dependence from lytholo-gical composition of rocks.The first type of relief is characterised usualy by even or slightly convex moderate steep turf slopes and gentle waterdivisions. Small cross trenches,which cutt the slopes of main valleys sometimes give the feather character to this relief. In connection with the loess cover often one can observe suffosion phenomena.

The second subtype of relief is characterised by convex slopes with fracture of soft underlying rocks at the border. Here is usualy worked out narrow like valley, often with steep and rocky slopes.

The third subtype of relief is characterised by steep convex slopes either slightl turfed,or croppedout and rocky. The waterdivisions most of all preserve gentle forms, which is,apparently, connected with character of the Pre-Neogene relief.

The formation time of this relief envelopes the period since the second half of th Upper-Quaternary epoch up to present time.

Steep-sloped small-ranged relief often being transformed in the feather relief which is widely developed (fig. I0I). It is developed mainly in the extreme North-East part of the area and dimensionally is connected with the area of development of soft Neogene rocks and covering them the loesses. It is developed at absolute altitudes from 600 up to I700 m, the depth of valley cuts usualy does not exceed 60 m. The valley slopes are comparatively steep,often convex,usualy with turf.The waterdivisions are gentle,rounded or flattened.

Subparallel character of these trenches because of the inclination of the plain often had been faulted and transformed into disordered branching,thank to which the small-ranged relief at separate areas became likerelief " bad land " The period of formation of the described relief-is the middle of the Upper-Quaternary epoch up to present time.

Steep-sloped small-dissected relief "bad lands ".

The period of formation of the described relief is the middle of the Upper- Quaternary epoch up to present time.

Steep-sloped small-dissected relief "bad lands" (fig. I03) has very limited distribution and it is developed at some areas, composed by easily fractured soft Jurassic deposits (left side of the Surkhab river between village Tala and Dashti-Saphed and in the vicinity of the Karkar mine.) and Eocene and Miocene sandy-clayey and gypsum--bearing rocks (Dashti-Saphed,Madr,Ferozak). This relief is developed at the areas, having small knickpoint of altitudes. The relative excess of valleys above waterdivisi here rare exceed I50 m,in average they amount about 80 m. The described relief is notable for disordered drain net,which have temporary character ,high degree of outcroppi steep,often small rocky sharacter of slopes, sharp bed-river knickpoints (up to I0 m), conditioned by lythology change. The described relief began to form at the end of the Upper-Quaternary period and still continues on.

Structural-Denudation relief occupies about 30% Of the investigated territory.It is represented by the middle-mountain relief with absolute hights within the limits of I000 up to 4000 and with depthof valley cuts up to 200 m. The main factors ,which

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formed the conditions for its formation were ,apparently,the following: comparatively slow and irregular tectonic uplifting of the whole area; equivalent showing of the processes of erosion and denudation or even the domination of the latters and ,finally, the existence of more dense rocks,which underlyy soft deposits.

Depending upon amplitude of tectonic uplifting of different parts of the territory concerned,as well as on peculiarities of the formed before tectonic structures, the development of structural-denudation relief was different at separate areas. Thank to thi this fact had been worked out the following types of relief:

BIa - flatten-hilly or hilly- ridgy relief.

BIb - swell-like ridged relief,transformed into hilly and

BIc - cuesta relief and relief of monoclinal ridges.

Flatten-hilly or hilly-ridgy relief (fig.) has a limited distribution. It is confined only to small areas,where in negative tectonic structures (synclinals) were preserved soft Neogene(Pliocene) deposits. Here, in dependence on intensity of the erosion-denudation processes had been worked out hilly or ridgy relief with comparatively gentle turf slopes and rounded or flatten tops. Thelatter are the relicts of the general accumulation-denudation surface,which existed here at the Post-Pliocene period before or at the beginning of the general tectonic uplifting of the investigated territory.

Swell-like ridged relief,transformed into hilly (fig. I05) has wider distribution among the described subtype. It represents irregular combination of hills and swell--like ridges ,sometimes having considerable sizes.

The hills are usualy rounded izometric or irregular stretched with top excessabove drain bed up to I00 rare 200 m. The slopes of such hills are comparatively gentle,stony (limestones),rare slightly turfed. The form of the hills usualy does not answer the tectonis structure of the deposits. Rare it roughly coincides with gentle cupola-like anticlinal structure.

Swell-like ridges observed for example, in the South-West of the area (the Kamard right side of the river, interfluve Askhoraka and Chakhar-Dec,etc.) have length from 6 up to 28 km and width from 2 up to 4 km. They represent the having been prepared from soft Neogene-Quaternary cover anticlinal foldings,composed usualy by massive limestones and having the East-North East direction,which coincides with general structural plan of the Neogene and Post-Neogene tectonic movements.

The slopes of such swell-like upliftings often are assymetric and considerably worked out by exogene processes (rain channels,rocks, talus,etc.) and only at some areas pointed at the geomorphological map by the special mark, represent unfaulted structural surface. Often slopes of such swell-like different upliftings are complicated with outwashings,expressed in relief in the form of scarps. "Arch parts" of such swell-l--like upliftings preserved also differently;more often they are gentle slightly turfed spaces,which answer in general the form of primary arch of foldings. The typical is that the existence of cross epigenetic through valleys,which cut these swell-like upliftings.

The described relief formed,apparently, in four stages,which answer the main falling--rising movements of the investigated territory. First of all ,as the result of general uplifting,took place the preparation of the territory from soft Eocene deposits up to armoured mass of the Dat-Paleocene limestones. Then on this limestone surface were deposited the Neogene roughly Terrigene rocks of the Rustak suite. At the third stage this surface,at the beginning of the Quaternary period as the result of new tectonic uplifting of the territory, again was prepared already from the Neogene soft deposits. The latter were preserved only in synclinals.At the Quaternary period the whole surface was overlapped with loesses and loess-like rocks. The prepared surface for this last period of the formation almost did not change because of little relief energy,stability of its rocks and lack of surface drains. The larger river systems,such as Askhorak,Poi-Tagi, Chakhar-Dekh,Sary-Tor,Pashagol and Surkhab,which were deposited at the earlier time, apparently, at the end of the Neogene-at the beginning of the Quaternary period) on some areas,envisaged by structural-tectonic peculiarities (gentle arch-like lidtings,fracture faults,etc) had eroded the structural surface. As the result were formed the areas in the form of erosion windows and more extensive spaces with area of the first dozens up

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to the first hundred km^2 . On these areas at the later period (Post-Neogene) had been worked out the yuonger erosion-tectonic relief. These areas are well seen at the maps (geological and geomorphological) attached.

Cuesta relief and relief of monoclinal ridges (fig. 106) is of little distribution. It is known at two areas in the Puli-Khumri region and along the left slope of the Saigan and Surkhab rivers up to village Tala. Here the cuesta relief has the extension of up to 60 km with width up to 3.5 km. At the both areas cuesta relief is formed by the Cretaceous-Paleogene rocks,and by the Upper-Jurassic -at the Puli-Khumri area. In both cases the surface of cuesta is armoured by massive Dat-Paleocene limestone having dipping from 18 to 25 ^{o} . The trough altitude of cuesta reaches 450 m.

The cuesta relief was formed as the result of deep erosion cut of the valley along the anticlinal arch and simultaneous long-time denudation processes, which have prepared which have cleaned the cuesta surface from soft formations.In the Puli-Khumri region by the Surkhab river valley was deeply cut the Puli-Khumri anticlinal. In the area of the Saigan and Surkhab rivers of the cuesta had been formed as the result of deep erosion cut of the valleys of the same rivers in the wing of flexure-like folding,which was formed at the junction of the Mesozoic platform and Paleozoic folded bench which underwent considerable relative uplifting at the end of the Miocene (the Pre-Rustan uplifting).

Denudation-accumulative relief has very rare distribution occupying several percent of the whole square.This relief had been formed by the processes,among which dominate the processes of accumulation and subordinated meaning have the denudation processes. As the result of this one can single out the subtype of denudation-accumulation relief with accumulation domination (CI).

In dependence on genesis of accumulative formations one can single out the four types of relief:

Horizontal-plain relief,formed by horizontally lying alluvial-talus-laky deposits (fig.108). This relief is connected with the accumulation of the alluvial-talus and laky deposits in intermountain depressions,such as the Ishkamysh and Puli-Khumri. This relief is represented by absolutely even horizontal,sometimes being swamped surface,which usua is used for agriculture lands. The process of formation of this surface,which had start at the MiddleO - Quaternary period (after the period of loess deposit), goes on at the present time.

Poorly inclinated plain relief,formed by closed cones of debris cone and by the talus-prolluvial trains (fig. 109). Theformation of this relief is connected with debri cone into intermountain depressions of the Alluvial-Talus material by periodic floods and small constant rivers,which lose fresh power at the outcrop at the surface. Because of this the space situation of this relief is completely certain- It contours the mountain areas,occurring at the border with intermountain depressions, and in the foot of mountain slopes,in the mouthes of big river valleys. Debris cones with their small sizes are not separated from the Talus-Prolluvial trains. Morphologically they are separated from the latters only having the big sizes.In these cases the debris cone surface is characterised by erosion trenches and rain channels dissection; in head part very often one can mention mudflow bars, the heap of large block material,exotic blocks. Peripheric zones of large debris cones are usualy represent even,often ploughed up under agriculture lands surface.

The Talus-Prolluvial trains of the foots of mountain slopes also have all these signs,but more poorly expressed. More often they have inclinated even surface,which is like peripheric parts of large debris cone.

The period of the formation of debris cone and the Talus-Prolluvial trains,mainly, envelopes two stages: ancient-Upper-Quaternary and modern.The ancient -is characterised by wide distribution of the Prolluvial surfaces,their evenness and turfness.The formation,apparently, answered the Pluvial (Vurm) of the second half of the Upper-Quaternary epoch. The modern -is characterised by limited distribution,usualy it is overthrust on ancient surfaces and is notable for extrene freshness of the Prolluvial debris cone.

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In formation of the Prolluvial-Talus sections of the mountain ridge foot the age grade is expressed less distinctive,and sometimes simply it is difficult to determine the age.

The flatten relief of erosion-accumulation terraces benches is very rare developed. This relief is more often developed in the valleys of big rivers,such as The Pharkhar, Chal(Tangi),Surkhab,Saigan,etc. In the valleys of long rivers one can manage to single out two types of relief of erosion-accumulation terrace benches, which are notable for different hight and period of formation.

The flatten relief of benches of complex of upper and middle erosion-accumulation river terraces (CI c),developed within the limits of 60 to 220 m above modern water line in rivers. This complex usualy is worked out by modern exogene processes,more often has relictic character. Only in the Surkhab and Farkhar valleys one can observe terrace benches of this complex,which are expressed more distinctively. Usualy they do not exceed in width of I50-200 m and only sometimes reach I.0 km (the left side of the Surkhab river in the Kalagai area).Their extension ranges in limits up to 2,rare 4 km. The most distinct tive are the low benches of complex. They in most cases have local character. The age of the formation of terrace benches is in interval from the end of Low-Quaternary up to the end of Upper-Quaternary periods.

The flatten relief of benches of complex of low erosion-accumulation river terraces and Alluvial-Talus accumulation plain of modern beds (CIc) is developed wider and practically is typical for all big and small rivers and temporary floods. The benches of terraces of this complex tower above up to 30-35 m above level of modern beds. At thses benches are situated villages and cultivated the agriculture lands. Their width often reaches I.0 m and as an exception -3 km (the Surkhab valley in the Kalatai area). The modern bed if not filled with water flood,usualy have pebble- boulder surface and width from first meters up to I.0 km.

The flatten relief of slopes and slightly inclinated plains,formed by the Prolluvial -Talus processes (ICc) has a limited distribution.This relief is developed at some areas a among the low-mountain erosion-tectonic relief,and at the junction with accumulative relie forms of intermountain depressions or at the slopes of wide old valleys. In both cases takes place the slow outwash by the Talusor Prolluvial-Talus processes of fine-grained material from gentle slopes and its accumulation both at the slopes,and in the valleys. This relief is characterised by gentle plain character without considerable cuts or rain channels and usualy by complete turfness.The areas with such relief are widely used for agricultural lands.

The time of formation of this relief -the second half of the Upper-Quaternary epoch (after loess deposition) up to present time.

The specific types of accumulation at the investigated territory are represented by different genetic types.In general , they have very limited distribution. Among them are singled out the following:

Hilly- sink moraine relief,formed as the result of the deposition of side and ground moraines by glacial of valley and corrie types. This relief is usualy sharply worked out by the following processes and that is why not always one can distinctly diagnoses. Moraine relief is mentioned only int the west half of the investigated territory in the form of rare separate spots;their square usualy amounts I-2 ,rare reach 4-5 km^2. By hight position is singled out moraine relief low,developed in interval of absolute altitudes from 2000 up to 3200 m, and high- developed in interval 3500-3800 m. The first one has more expressed valley character and it is companied by the preserved riegels and stretched often at the distance of 4-6 km (in the form of separate spots.) These moraines date as the Middle-Quaternary (Middle-Upper-Quaternary).The second one has corrie character,more fresh arrearance and belongs to the Upper-Quaternary epoch.(Vurm?)

Steep-sloped relief of gravitated accumulations has practically wide development in the areas of erosion-tectonic middle-mountain relief,accompanying all its types. However,the gravitated accumulations with square ofmore than I km^2 and rare of 4-5 km^2 in general are met very rare. The age of these accumulations is usualy modern.

To this relief is referred the relief of land-slide mass,having a limited distribution. This relief in exceptional cases occupyes square up to I and rare 3 km^2.(for example, the

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left side of the Danai-Guri river,the left side of the upper current of the Chakhar-Dekh,etc.)The formation of this relief is connected with activity of underground waters at the areas with favourable tectonic structure.

The history of relief development and of area hydrographic net is closely connected with its tectonic development during the Neogene and Quaternary periods. The tectonic movements which brought to the accumulation of the Rustak terrigene strata,showing at the end of the Miocene or at the beginning of the Pliocene,apparently, the earlier which determined the direction of hydronet ofthe area. These movements were shown along the Ishkamysh marginal suture,separated the Mesozoic platform from folded Paleozoic mass,situated to the South-East from it. They were expressed first of all in lifting the whole mass above platform and laying the first elements of the future marginal foredeep at the North-East of the area. This uplifting determined the direction of the surface drain to the North and to the North-West at the whole investigated territory. However in the South-West part of the territory these movements had less differentiated character than in the North-East. The movement along the marginal suture had no distinct expressed fracture character and brought to the formation of flexure-like bend,which was situated along the modern Saigan and Surkhab rivers (at least up to the latitude of Tala village). This flexure-like bend determined in further the direction of the Saigan and Surkhab valleys.

The general uplifting of this part ofthe investigated territory brought to the intensive denudation of the Mesozoic and Paleogene deposits. At the square,situated to the South-East from the line roughly coincided with the Saigan-Surkhab direction, beyond the investigated territory this denudation was more intensive and brought to complete destruction of the Mesozoic cover. At the square,situated to the North-West f from this line the process of denudation brought only only to the cleaning of the Paleogene massive limestones from soft cover of Middle-and -Upper-Eocene deposits.At this period (at the very end of the Miocene) the whole territory of modern development of structural-denudation relief is thought as very close to its modern appearance,but avoided of erosion windows and squares with erosion-tectonic relief. At the low Pliocene the part of this territory was covered by terrigene deposits of the Rustak suite,thickness of which was irregular,but thank to the favourable inclination of this surface to the North,thickness little by little increased in the same direction.

The gradual uplifting of the investigated territory at the following time(during the whole Pliocene) brought at the end of Pliocene-at the beginning of the Quaternary period to the final foundation of the Saigan and Surkhab valleys,which coincide in general with modern direction. At this time also had contoured cuesta relief at the left side of the mentioned rivers,about which speakx the Pliocene-Ancient-Quaternary deposits,having been accumulated in the Saigan valley,not far from cuesta trough. To this time were layed all the main large tributaries of the Surkhab river.

At the Low-Quaternary period were layed in the West of the Chakhar-Dekh,Sari-Top and Shabashek,Askhorak and Poi-Tangi rivers,which give the start of the Doab,Pashakul rivers,etc. The direction of these rivers had been controlled by general surface inclination of drain to the North at the period when the surface was covered by soft deposits of the Rustak suite. The large river valleys at the following time developed as epigenetic (Alma,Doab,etc. rivers).At the same time at the end of Low-Quaternary epoch the tectonic tensions brought to warp of structural-denudation surface,composed by the limestones of the Dat-Paleocene.As the result of this were formed antecedent areas of valleys (Chakhar-Dekh,Sari-Top,Shabashek).The further valley deepening brought to the formation of erosion windows,within its limits the armoured plate of limestones of the Dat-Paleocene was completely eroded and the process of the formation of erosion-tectonic relief began.

The process of the relief formation strenghened in the Pluvial of the Middle--Quaternary epoch when the formation of glaciers of corrie and valley types began.It is unlikely that at this time structural-denudation limestone surface was covered by complete snow.However the conditions for forming complete glacier cover are absent here.

In different way took place the development of relief in the North-East part of the investigated territory.

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At the beginning of the low-Quaternary epoch here appeared movements along the Ishkamysh marginal suture. At this time took place the basic upliftings and the overthrust from the South-East at the Mesozoic platform of the folded paleozoic mass and partially enveloped with it the Mesozoic (Triassic,Jurassic).In this area there is no Low-Quaternary deposits,but they are widely developed in the areas situated to the North and North-West where are developed the roughly terrigene,often bouldered Low--Quaternary deposits (Mazari-Shariff and Shordarai suites).This all explain the strong tectonic movements.As the result of these movements the North-Eastern platform part of the area became relatively sinking.One could not observe noticable accumulation of sediments at the Middle-Quaternary epoch.

AT the end of the Middle-Quaternary or at the beginning of the Upper-Quaternary epo epochs takes place the foundation of the Ishkamysh and other young depressions,in which forms the plain accumulative relief.

At the Upper-Quaternary epoch (the first half) takes place the process of loess--deposition.The loess covers the worked out before relief within the limits of the whole investigated territory ,covering the mountain slopes and fulfilling small valleys. But at the second half of the Upper-Quaternary epoch stops the loess-deposition.

At the second half of the Upper-Quaternary epoch the moistening of the climate makes favourable conditions for appearance of small glaciers of corrie type. At this time starts the process of " becoming free the relief from the loess cover,especially intensively showing in the areas with sharp erosion relief.This process still goes on, which can be seen in river valleys Chala,Zamburak and Namakab.Simultaneously with this at the loesses and loess-like loams lays steep-sloped large and small gidged relief.

At our present increased the aridness of climate; debris cones sharply deminished in size;small rivers because of water lack cannot evacuate destruction products (gravitated,Talus),which little by little block up the river beds. Very often is observed the filling of the valleys by modern deposits and complete extinction of small rivers,which is especially seen in the West part. In this respect a certain role plays agricultural activity of a man.Separate rivers,even not veri little,completely are dewatered in the low and sometimes middle current because of the water fence for irrigation of fields (for example,Nakhrin,Shoraw,etc. rivers).

CHAPTER VIII. USEFUL MINERALS.

Within the limits of the territory concerned the primary aim of geologo-surveying and searching works was the foundation of hard coal deposits,elicitationof perspective squares and receiving the recommendation for carrying out the further,more detail, search-prospecting works. The task was also to estimate the square according to perspective of coal-bearing and other ore and non-metalliferous useful minerals.

In this chapter are given the results of searching works in the following sequence:

A. Coal-bearing and description of deposits and hard coal manifestation;
B. Other useful minerals;
C. Heavy-concentrate sampling;
D. Metallometric sampling;

The map of useful minerals,which illustrates the present chapter,contains the consequently numbered all the found in the work process as well as earlier known deposits and the manifestation of useful minerals,perspective squares and dispersion oreols In the chapter there are some references to the corresponding numbers of objects,which are made at the above mentioned map.

A. COAL - BEARING

The first information of the presence of hard coals in Northern Afghanistan refer to 1885-1887 (Grizbakh),then to 1911 (Gaiden) and to 1940-42 (West)[x] However they all concern only some dissected areas and do not give an idea of coal-bearing character, enveloped by geological survey of the territory.

In the process of aquaintance with materials and during the survey works had been established that the perspective coal-bearing square in the Northern Afghanistan stretc

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at more than 700 km from the Farkhar river in the East up to the Gerat river in the West,with middle width of stripe in 50 km.This square amounts approximately 35000 km^2. In its different parts there are of little importance outcropps of different age coal-bearing deposits:Upper-Hard-Coal (Gerat province,the Palavan deposit,etc.),Upper-Triassic (Farib province,Dzhavdzhin,Balkh and Sari-Pul or Mirzaliang,Shabashek deposits) and the Jurassic.

To the latter are confined the most widely distributed manifestations and deposits of Hard Coal.The detailed description is given below.

The described territory of the distribution of coal-bearing formations,concluding coal -bearing strata of different age,with numerous deposits of the Hard-Coal and coal manifestation,confined in structural respect to the certain geologo-tectonic zone, one can single out under the name of the North-Afghan coal-bearing basin.

In genetic respect the North-Afghan coal-bearing basin according to some signs, mentioned before, belongs to basins of intermediate type.

In the South-Central and West parts of the investigated square the coal-bearing formations were accumulated in unrugged intermountain erosion-tectonic depressions. In the North-Central and North-East parts - the coal accumulation took place at the beginning of the Callovian,under conditions of the shore-sea alluvial depression.

The coal-bearing deposits mainly are represented by the Alluvial-swamp, Alluvial-- laky-swamp and swamp facies.

It is necessary to point out that the whole area of coal accumulation thank to its oisition in the marginal part of the platform was characterised by the showings of energetic differentiated tectonic movements,especially sharp at the end of the Jurassic (Andi stage of folding). These movements put a certain print on the lythologo-facial character of coal-bearing deposits,theit thickness,dislocation,showing of the vulcanism; they gave to the coal-bearing deposits the features specific for the basins of intermediate type.

In the North-Central areas and in the East of the investigated territory (Chal-Namakab and Puli-Khumri coal-bearing areas) in the Early-Alpine stage of development (the Low Jurassic) could be seen the foundation of pre-mountain trough. The formation of the trough and the manifestation of effusive activity was connected with the movements a along the Ishkamysh marginal suture,which limited the Mesozoic platform and the special development of the Alpine Tectogenesis.

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Thank to active tectonic movements,intensive sediment supply of terrigene material of the underwent upliftings of the South-East and South areas,periodical effusive activity here only episodically appeared the conditions,which were favourable for coal accumulation.About this speaks the presense of rare (2-3 beds,rare 4-5 beds),of little thickness coal beds,usualy complicated structure and in most cases characterised by the high ashness for the account of mineral mixtures.

The implacement of small intrusions and tensed tectonics had brought to considerable coal methamorphism in this part of the investigated territory.

In the central and west areas (Saigan-Ishpushtin and Darrai-Suf coal-bearing areas) at the period of coal accumulation (Triassic-Jurassic) had been dissected erosion-tectonic depressions,where also accumulated thick up to 2300 m coal-bearing terrigene strata of flishoid-like character,but completely avoided of effusives and little intrusions. The Ishkamysh marginal suture here is expressed undistinctly,and that is why in these area at its continuation developed flexure folding (Ishpushta area). Conditions for coal accumulation here had been different.

In the Saigan-Ishpushta coal-bearing area relatively narrow depression quickly was filled by the rough terrigene material and here relatively rare appeared the favourable conditions for coal accumulation,as the result of which the coal saturation of strata is low (only 2 beds).Coals refer to mark "G_v".

In the Darrai-Suf coal -bearing area depression had considerable sizes and started its existence since the Triassic. In spite of this fact that the area had been occupied by the water basin (lake)in its marginal parts existed the conditions favourable for coal formation,which constantly continued on from the uppers of the Triassic up to Jurassic including.Here were formed thick (up to 1500m) and the most coal-saturated strata of the Jurassic (up to 40 beds).

Conditions of hard coal lying at the whole territory are complicated thank to both either primary conditions of accumulation (lenses-like forms of beds) Or the following tectonic formations.

The latters,as had been mentioned,were shown the most sharply at the end of the Jurassic - at the beginning of the Cretaceous periods and brought to the formation of complicated fracture-folded faults in the Jurassic coal-bearing deposits. The following Pre-Cretaceous erosion ,apparently, had brought to considerable shorttening of primarily more wider areas of the distribution of coal-bearing deposits.

The peculiarities of tectonic development of the territory at the period of coal accumulation and the following time determined not only the conditions of area distribution and conditions of coal-bearing deposit lying,but a number of other peculiarities, such as coal saturation,high coal composition,their methamorphism,etc.

The coal-bearing deposits of North-Afghan basin at large areas are overlapped by the thick (up to 500 m) slightly dislocated deposits,forming the second (upwards)structural stage of platform mantel.Only in erosion windows,confined to the roofs of gentle anticlinal upliftings,and in marginal parts,uplifted by the large fractures, of tectonic blocks, in general at the comparatively inconsiderable areas are cropping out the coal-bearing rocks.The square of discovered of erosions of coal-bearing deposits constitutes only some percents of the whole basin territory.

In accordance with this the North-Afghan coal-bearing basin should be referred to the half-closed type.

Thus,in the whole for the North-Afghan coal-bearing basin is typical:

a) coals of different age (Carbonaceous,Triassic,Low-Middle-Upper Jurassic);

b) features of basins of transition type;

c) according to outcrop extent refers to the basins of half-closed type.

By the coal-bearing character,territorial situation and geological structure at its territory are singled out the following coal areas:

1. The Gerat coal area
2. The Darrai-Suf coal area
3. The Puli-Khumri coal area
4. The Saigan-Ishpushta coal area
5. The Chal-Namakab coal area.

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For each singled out areas is typical one or another peculiarity in sediment accumulation and coal-bearing accumulation.

Geologo-surveying works in Gerat area had been carried out in I963-64 and their results were elicited in the corresponding report (K.Ja.Mikhailov,V.V.Kulakov,V.P.Kolchanov,B.R.Pashkov and other,I965) The investigations which carried out inI963-65 envelop only the East part of the North-Afghan basin.

This square,which stretches from the Farkhar river in the East -up to the basin of the Darrai-Suf in the West,is the most open and includes,mainly, all the known before in the North Afghanistan the most considerable deposits and showings of the Carbonaceous ,such as: Dakhani-Tor,Shabashek,Ishpushta,Karkar,Dudkash,Nakhrin,Chal,Zamburak,etc.

In the process of works,besides the numerated deposits,at the investigated territoryhad been recovered more than 60 coal manifestation of different scale and two coal manifestations/ connected with the Upper Triassic.Besides,had been marked I7 areas, which are perspective for the organization of more detailed search-prospecting works for the Carbonaceous.For the most important objects such as Shabashek,Sary-Assia and Darrai-Kolon and some other had been recommended more detailed search-prospecting works,which had been executed by the coal-prospecting party during I964,I965 and I966.

However the estimated and more detailed geologo-prospecting works were carried out only at the large areas. For the estimation of these areas it would be necessary the to carry out the geological works of a large scale with using structural-ma p boring at the closed sqares.

Of the investigated deposits at present time the Shabashek deposit one can refer to the group of " Medium",estimated at the area of 70 mln. tons ans which has perspectives for increasing them in the process of the prospecting.

A number of deposits,such as the Ishpushta,Nakhrin,Naryn,Chal,Zamburak,Bazarak, Paluvana in the process of geological survey can be feferred to the group of "small" deposits,not having any perspectives for increasing coal reserves.

Below is given the short description of coal areas and deposits,situated at their areas.

Darrai-Suf coal area.

Darrai-Suf coal area is situated in the central part of Central-Afghanistan in Samangan province and unites a number of large Carbonaceous deposits.In its limit arch-like curved belt of coal deposits stretches from the Darrai-Suf valley in the West up to the Kara-Kotal deposit in the South-East and has the extension about 45 km with width of 6-7 km (Darrai-Suf-Kara-Kotal).

By the quantity of deposits the Darrai-Suf coal area differs much from the other coal areas and is the most well known at the territory of North Afghanistan. In its coal-bearing belt will be concentrated the basic reserves of the Carbonaceous,available for commercial exploitation.

At the territory of the Darrai-Suf coal area are situated the following Carbonaceo deposits: Lela,Dakhintor,Saritor,Garmak West, Garmak East, Karamkul,Darvaza,Changau, Daut,Shabashek,Sary-Assia,Sabzak-Kotal and Askhorag

Thank to the favourable conditions of coal-accumulation the latter had passed regularly since the Upper Triassic up to Upper Jurassic including.

The Triassic coal accumulation is characterised mainly by the formation of unnumerous of little thickness of coal interbeds (up to 0.4-0.5 m) which are of no practical importance, and only solitary coal beds in the Shabashek deposit reach the worki thickness (up to I.0 m).

For the basic,Jurassic,accumulation stage of coal is typical the formation of thick coal-bearing strata with the beds ofcoals of working thickness.The formation of the latters took place both in the Low and in the Middle-Upper Jurassic period. However the strongest intensity of coal-accumulation dates to the Middle Jurassic.

In the Low Jurassic, in the deposits of the Regbulak suite, the formation of working coal beds takes place only at some areas,in the areas of the Shabashek,Karamkul, Dakhnitor and Leila deposits. On the rest area are formed the coal beds of small thickness and interbeds. The quantity and thickness of coal beds are given in TableA.

/see report in russian,page 452 /

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The coefficiency of total coal-bearing of deposits for the Regbulak suite at the Dakhnitor deposit amounts 0.2%,and at the Shabashek deposit reaches 2%.Because of the complication of mode of occurrence of coal-bearing strata of the Karamkul deposit it is impossible to count the thickness of its section and hence the coefficiency of coal--bearing at this stage. At any rate the coefficiency of working coal-bearing for the deposits of the regbulak suite will be high enough.Thus, the coal saturation of the Low-Jurassic deposits of the Regbulak suite for different areas is different. The majority of working coal beds in section of suite is observed in the area of the Karamkul deposit and diminishes to the Danitur and Shabashek deposits,completely disappearing in the area of the Sary-Asaia deposit.

There all reasons to consider that in the deposits of the Regbulak suite (the Leila,Karamkul,Dakhnitor deposits and the Saritor, Changau,Daut areas) can be prospected the considerable reserves of the Carbonaceous.

During the Middle Jurassic at the territory of the area takes place the most intensive coal accumulation as the result of which was formed the most part of the working coal beds of the investigated deposits.The Shabashek suite is fixed and traced at the square of the area and has the highest coal-bearing coefficiency.With the deposits of the Shabashek suite is connected the working coal-bearing of the Leila,Darvaza,Garmak West, Garmak East,Shabashek,Sary-Assia,Sabzak-Kotal and Askhorag deposits.The thickness of the suite in the area ranges from 360 m (Leila II) up to 450 m (Shabashek). The quantity of the working coal beds in section of the suite ranges from 5 (Shabashek) up to II (Sary-Assia). The most part of the beds of the all deposits of the complicated structure is relatively stable as to thickness and structure. The quantity of coal beds,their thickness and structure are given in the following table. /see Russian report,page 455/ The coefficiency of the total coal-bearing of the Shabashek suite is the highest of all suites of the Jurassic and reaches at the Shabashek deposit 6%,and in the area of the Sary-Assia deposit - 9%.The high coefficiency also will be in the area of the Garmak West and Garmak East deposits.

To the North and South from the mentioned deposits the coal-bearing of the suite diminishes considerably.The coefficiency of the total coal-bearing at the Lela deposit amounts 2% and in the area of coalmanifestation Askhorag only 0.5%.The coefficiency of working coal-bearing is the highest at the Sary-Assia deposit - 5.5%.

In spite of the fact that the Upper Jurassic deposits (Bashek suite) are widely developed in the area,the commercial coal-bearing in the latters is observed only at the Shabashek deposit.At the rest known deposits (Dakhnitor,Lela,Sary-Assia)in section of the Bashek suite are observed only some separate of little thickness coal beds and coaly beds and coaly argillites.The coefficiency of working coal-bearing amounts %. In total at the Shabashek deposit in the deposits of the Upper Jurrassic had been recovered 7 working coal beds;their thickness and structure are shown in table:
/see Russian report,page 458/.

Beds I6,23 and 27 are very stable at the prospected area of the deposit.Beds I3,I4 and 22 are relatively stable and have working thickness only at the part of the deposit.

The square distribution of the coal-bearing strata of the Upper Jurassic,for the exception of the investigated part of the deposit is not determined.Apparently,the working coal-bearing of the Upper Jurassic has unconsiderable distribution and is limited by the area of the Shabashek deposit.

The lying of the coal-bearing deposits of the area because of the complicated general tectonic picture-complicated and is characterised by a number of steep enough anticlinal and synclinal foldings of sub-latitude strike with dipping angles of wings up to 30-60°.Besides all these foldings is observed and more fine folding of the type of flexure bed bends.In general structural plan a number of deposits of the area such as: Dakhnitor,Lela,Karamkul,Darvaza,Sary-Assia, are confined to anticlinal foldings or their wings. The Shabashek deposit represents assymetric synclinal,which is plunging to the East and complicated by a number of more small foldings.The folded structures are complicated by the fractures,which usualy are sub-parallel to axis of the foldings with the displacement plain dipping to the South with angles of 50 up to 70°. By the fractures the northern blocks mainly are overthrust on the southern.The cross fractures are met very rare.The occurrence of coal beds at the deposits is different and depend on the

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complication of tectonic situation of one or the other area.The most persistent bed lyings are observed at the deposit Dakhnitor-with dipping angles of 35°;Lela-40-55°; Sary-Assia-35-75°. At the Shabashek deposit the coal beds of the northern wing of synclin have angles of 30-55°, of the sothern -40-50°.

For the coal-bearing belt of the deposits Garmak East,GarmakWest,Karamkul,Darvaza is typical extreme inpersistance in lying of coal beds because of the fine folding and fracture faults (dipping angles change from 30 up to 85°). The detailed characteristics of the mode of occurrence of coal-bearing deposits and coal beds at separate deposits are given in describing the latters.

Coals of the Darrai-Suf coal area are Carbonaceous,of different extent of methamorphism.

Coals of the Dakhnitor,Lela and Darvaza deposits are gas medium-methamorphised, medium and little-ashed.Coals of the Darvaza deposit are ashed and with high content of ash.Gas Show ranges from 32 up to 38.7 % and depends upon the microcomponent composition of coals.Coal dressing is medium. Coals are the good energetic fuel.(Gas show is given for inflammable mass ^{g}; ashness- A^{c}.On base of the petrographic studywas established that the coal of the Dakhnitor deposit can be used in the process of carbotization. The dressed unoxidised coal can give independently coke with remnant in drum of 245-265 kg

The extent of methamorphism of coals of the Garmak West and East deposits is below and the latters are referred to mark G -gas little-methamorphised. Coals are mainly with little percent of ash.The gas show ranges from 34-45%. They can be used as good energetic fuel.

The coals of the Karamkul deposit are characterised by the low methamorphism and are referred to gas-low-methamorphised.Here are present coals of all ashness groups- - with little ash,medium-ash,and high-ash with gas show from 37 up to 55%.However one should point out that all coal beds of the deposit were sampled in the zone of weatherin (moisture ^{a} - 8.I2 up to II.68 %) and the results of the qualitative characteristics of the latters aan be distorted.

The lowest extent of methamorphism is observed in the area of the Saritor coal- -manifestation,where coals are referred to mark of the long-flameed.To the most detaile study had been submitted coal beds of the Shabashek deposit in carrying out the prospecting works (Androsov B.N.,Kudriashov N.S.,Saidalikhodzhaev G.N.,Marshansky I.I.1965). Here according to the accepted in the USSR standards had been established that coals sho should be referred to the mark of gased,to group Y_{6} ,and coals of the upper beds (23-26 to mark D -long-flamed.The content of Sulphur changes from 0.2I up to 0.72 that is these coals are of little Sulphur(except bed 27,where in total -I.62%).The Phosphor percent ranges within the limits of 0.33-0.I03% and only by beds 8 & I3 coal is low-Phosphor (0.004-0.0I4%).Calorificcoal ability ( ) ranges within the limits from 7620 cal. up to 8250 cal. It is established that calorific coal ability diminishes upwards by section. Moisture (^{a}) of slightly oxidised coals changes from I.7I up to 2.62% (by holes).The thickness of plastic bed ( ) in the low beds I-8 ranges from 0 up to I3 mm,in beds I3-I6 about 6 mm(4-8 mm).In sampling of the upper beds 23-29 the plastic bed was absent.

It was established that at the deposit from depth I2 m coal is practically is un- oxidised.The moisture of coal at this depth becomes constant from I.I9 up to 2.76 %. Coal dressing (on the base of petrographic study) is light and medium for fine classes (in crushing up to I.5 mm) and difficult for large classes.

In determination of caking capacity according to Rog was found a certain dependence of caking properties for low beds of petrographic composition and ashness.

Vitrinite percent (%)	ashness (%)	caking to Rog
82-85	up to I0	I9-24
73	I5	I2
59-7I	I3-2I	0

On the base of the carried out investigations in the Darrai-Suf area one can mentio a certain laws for increasing methamorphism extent of coals with stratigraphic depth (very distinctly it was established at the most investigated Shabashek deposit).

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About this speakes the fact that coals of the Regbulak suite of the Low Jurassic at the deposits of the Dakhnitor,Lela, are situated at the under-stage of gas medium--methamorphised (Vitrinite reflection index - 80 %) and coals of the Shabashek deposit the under-stage of gas high-methamorphised (Vitrinite reflection index 0.8I-0.94 %). Exception is coals of the Karamkul deposit,where coals are referred to gas low-methamorp sed and at the Saritor coal manifestation -to long flamed. Apparently,this can be explai ned by the fact that coal beds of the Karamkul deposit are confined to anticlinal structure,did not undergo deep plunging at the period of the formation of the overlying strat

Coals of the Shabashek suites and Bashek suite unlike to coals of the Regbulak suite are less methamorphised (Deposits Shabashek,Sarry-Assia).

In the section of the Shabashek deposit is observed the laws of increasing the extent of methamorphism of coals from the upper beds to the lower ones. The changing of coal properties (by sample concentrate of the deepest minings), is expressed in the following:

a)increase of Carbon percent from 8I up to 83 % and reduction of oxygen percent fro I2 up to 8.5 %;

b)increase of caloric capacity from 7900 cal. up to 8200 cal.;

c)increase of caking capacity,conditionally expressed by the depth of plastic bed from the marked bed up to I2-I3 mm .

Simultaneously with the increase of methamorphism,with stratigraphic depth at the Shabashek deposit is observed the increase of coal methamorphism with increase of the depth of the bed lying.Thus, the Darrai-Suf coal area,especially at the area of the Shabashek deposit, is perspective for finding here coals of higher stages of methamorphism available for coking.Especially,this refers to low horizonsof the Regbulak suite and the Triassic deposits,which are slightly studied and must be included at the objects of the first turn of searching-prospecting works.

Saigan-Ishpushta coal area.

This area is situated in province of Bamian,in the middle flow of the Surkhab river. The Saigan-Ishpushta coal area is notable for unfavourable conditions for coal accumulation.The Jurassic deposits represented by all divisions with angle unconformity occur on the Triassic rocks.The total their thickness ranges from I370 m up to I520 m. The coal-bearing is confined to low part of the middle Jurassic,occurring with angle unconformity on the Low-Jurassic deposits.

The coal-bearing strata can be compared with the Shabashek suite of the Shabashek deposit of the Darrai-Suf coal area.However by substance composition it differs from the latter by the domination in the section of conglomerates and coarse-grained sandstone The coal percent is also lower.

In the section of coal-bearing strata of the area (thickness in 260 m) are included 5 beds and interbeds of coal.The coefficiency of general coal-bearing amounts 0.8 %. At the Ishpushta deposit are known two beds of working thickness (I.49 m and 3.50 m). At present time is exploitated coal bed with thickness of 3.5 m

Coal beds are of complicated structure and inpersistent both by strike and by dippin The bed pinching out to the West and East from the exploited area was established. The coal-bearing strata occures monoclinally with bed dipping angles of 35-55 ^{o} to the North--West.

Coal reserves are limited because of small area of commercial coal-bearing distribution.

Besides the beds of the Ishpushta deposit in the area are known a number of coal manifestation with uncommercial coal-bearing (Tala,Barfak,Nalak,Komard). All of them are confined to one coal-bearing strata and they are of no practical interest.They only point out at the disappearance of commercial coal-bearing to the North-East and South--West from the Ishpushta deposit.Coals of the working beds are gas, with little percent of ash.

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Puli-Khumri coal area.

It is situated in the eastern part of the basin,in Baglan province,and unites the located at its territory the following coal deposits :Karkar,Dudkash,Sagach and Nakhrin.By conditional coal accumulations it sharply differs from the Darrai-Suf area. Here in the Low Jurassic is shown the vulcanic avtivity and together with the Terrigene sediments the Vulcanogene material.

The Dogger deposits and the most part of the section ofthe Callovian stage are characterised by the presence of coarse-grained material,conglomerates,gravellites,sandstones.And only in the upper Terrigene strata of the Callovian there is a band of fine--grained,sometimes red-coloured rocks,among which are concluded coal beds (the Karakar and Dudkash deposits).

The thickness of coal-bearing band here does not exceed I5-20 m.Above coal -containing band occure sea deposits of marbles,limestones,characterised by the sea Callovian fauna.Thus, coal accumulation in the area of the Karakar and Dudkash deposits took place at relatively short period of the Middle Jurassic (Callovian stage),at which then started sea transgression,which completely fractured the coal accumulation processes. In the coal-bearing strata there are 3 beds and coal interbeds.Thickness of working bed ranges from 0.6 up to 6.0 m,Coefficiency of total coal-bearing capacity amounts I %. The occurrence of coal beds is complicated by the existence of small and large fracture faults.Dipping angles of beds are from 20 up to 35 °.

The Nakhrin deposit is slightly isolated and here the coal-bearing capacity is connected with the deposits of middle and low Jurassic divisions.Here had been recovered 4 coal beds with thickness from 0.90m up to 4.40 m ,not taking into account interbeds of little thickness.It is possible that the quantity of beds is even more (up to 8). However,in connection with the complication of tectonic structure of the deposit the parallelatisaton of beds without special works is difficult.The coefficiency of total coal-bearing capacity of the Nakhrin deposit amounts about 0.4 %.

The structure of beds is complicated.The distribution of the square of coal-bearing strata is extremely limited. The deposit does not represent practical interest for the development of coal-production industry.Coal of the thickest bed at present time periodically is produced by the population of small troughs of outcrops.

In the whole for the most perspective part of the Puli-Khumri coal area (Karakar and Dudkash) is typical little thickness of coal-bearing deposits,little quantity of coal beds,complicated and unpersistent their structure,strongcrumbleness of coal;The existence of small and large fracture faults at the squares of the deposits with dislocation of coal-bearing strata.

Coals of all deposits,for an exception of the Nakhrin deposit,can be referred to long-flamed and transited from long-flamed to gas ones.By the ash content (30-34% and Sulphur (up to 2.5%) they are referred to high ash,medium-Sulphur coals and can be used as energetic fuel.

In the area of the Nakhrin deposit the methamorphism of coals is higher and the latters can be referred to gas,high ash coals.Because of inconsiderable scales of the deposit and complication of coal bed occurrence,as well as of strong crumbleness of coal up to foliated rubble.Coals of this deposit can be used only for local needs.

Chal-Namakab coal area.

The Chak-Namakab coal area is situated in the extreme North-Eastern part of the North-Afghan coal-bearing basin (Talukan province)It occupies an isolated situation in t basin,which is explained by facial and geotectonic situations existed at the period of coal accumulation.

At its territory (and the area of the Puli-Khumri area) in the Low Jurassic had been noticed piedmonte trough. Its further development brought to the accumulation of thick coal-bearing terrigene sediments (up to 2500 m).The coal accumulation periods in the low Jurassic changed by the periods of the resuming of vulcanic activity- eruption of effusives and the tuffogene material deposits.Vulcanic activity completely is over in the Middle Jurassic.In the deposits of the Low Jurassic together with the Terri-

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gene material and coal beds occure the Tuff-sandstones,Tuff-lavas,Tuffs,tearing dikes and stocks of middle and main rocks.The deposits of middle and upper Jurassic are represented by the Terrigene sediments of flishoid-like character with the coal beds, included among them.

In connection with intensive filling of the developing piedmonte trough by the Terrigene material and frequent resuming of vulcanic activity,favourable conditions for coal-accumulation appear very rare.During the following geological periods in the proc s of further development of trough and accumulation of thick strata of xemogene,organogene and terrigene sediments,coal-bearing deposits were plunged at the considerable depth and in the process of tectonic movements underwent complicated processes of folding formatio All this put a certain print upon facial composition of coal-bearing deposits and their methamorphism.

Geological structure of the area is characterised by the presence of complicated folding of numerous large and small fractures,which complicate more its structure.

Coal beds have basicaly steep angles of occurrence and in number of places are conf: e to small foldings,amplitudes of wings reach hundreds,sometimes several dozens meters. (the Bazarak deposit).

The coefficiency of total coal-bearing of the Low Jurassic amounts 0.5 %,of the Middle -0.3% and the Upper -0.4 %.

At the area are situated the following deposits and coal manifestations: Chal,Darrai -Kolon,Zamburak,Bazarak,Roshag,Namakab and Kishakton.The most part of the coal beds at th numerated deposits has complicated structure.Thickness of beds range from 0.20 up to 4.8 The quantity of beds and their structures are given in table (see Russian report,page 470.

The complication of geological structure of the area does not allow to carry out coal bed correlation of separate deposits without carrying out prospecting detailed work .

Coals of the Chal-Namakab area alike from other areas of the basin have high extent of methamorphism.This can be explained by regional methamorphism,dynamo-methamorphism and by the influence of thermal and contact methamorphism (see general table of coal analysis results).

With the aim to find the coking marks we carried out special petrographic and technological studies of coals.In connection with the marks precedeed to investigators about possible occurrence of such coal in the Chal-Namakab coal-bearing area (the Chal,Zamburak deposits),coals of the Chal,Bazarak,Darrai-Kolon,Namakab,Roshag,Zamburak) deposits had been submitted to more detailed study.The general results of petrographic and technologic studies and methodics are mentioned below.

Petrographical investigation of coals,carried out in 1966 hadbeen executed with the aim to desipher coal methamorphism of each coal-bearing area.In connection with this the metodics of work had been slightly changed and added by a number of non-standard determinations,accepted at some laboratories in the USSR.

The determination of methamorphism of coal carried out by polished sections-brickets of crushed coal in glicerine immersion.In this process was used the method of doubbled polished sections by A.B.Travin.This method represents the comparison of Vitrinite colour and spores of standard and studied coals.As standard was used regionally methamorphised coals of the Karaganda Carbonaceous basin of the following sub-stages:"G_h ", "F_m","F_h", "C_l","C_m ". These substages at the reflection light have the following distinctive signs

"G_h " - gas high-methamorphised.Shells of spores are black and brown-black,Vitrinit and Semy-vitrinite are very distinctive.Vitrinite is of dark-grey colour with slight brown tint.

"F_m "- fat middle- methamorphised.Spore shells in polished sections with glicerine immersion,grey with brown tint,contrasts of vitrinite and spores are distinct.Vitrinite is of grey colour.

"F_h"-fat high-methamorphised.Spores are characterised by light-brown tint of grey colour.Contrasts of vitrinite and semy-vitrinite are poor.

"C_l"-coking little-methamorphised.Spores are grey with ash tint,often problematic. Contrasts between vitrinite semyfusenite and fusenite are distinct enough.

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"C_m" -coking middle-methamorphised.Spore shells in simple reflected light are not seen.Contrasts between vitrinite and fusenite are slightly poor.Vitrinite is light--grey with bluish tint.

As the coals of the majority of the deposits Chal-Namakab coal-bearing area had been submitted to thermalaction,special attention had been paid to micro-petrographical signs,In correspondence with literature data and factual observations the action as it follows:

simple reflected light	:	polarizated reflected light
I.Milk-white tint of Vitrinite		I.Thepresence of strong anizotrope fusen-like form
2.Fine irregular porosity at vitrinite grains.		2.Fine strong anizotrope (graphitised?)margines around fragments of semy-fuseniteof micrinite.
3.Uneven "wrinkled" surface of vitrinite grains.		3.General anizotropy of vitrine grains.

By comparison of the studied coals with standards it was established that in the Chal-Namakab area there are no coals lower by methamorphism extent than "F_h",and in the Darrai-Suf and Puli-Khumri areas can be met coals,methamorphised not higher than substage "G_h".According to graphic of dependence of petrographical and technological parameters, being composed for regionally methamorphised coals of the Kuznets basin (USSR),coals of low methamorphism,even under favourable ratio of fusible and emaciated microcomponents, cannot have caking capacity more than I2-I3 mm (fig. III).The latter is confirmed by the technological test of the Shabashek coals.

From the other side coals of the Chal-Namakab coal-bearing at the same graphic must show more high caking capacity (up to 20-22 mm), if their extent of methamorphism was conditioned only by regional reasons.But for the majority of the deposits of this area petrographically was proved thermal character of methamorphism of coals.For this type of coals the estimation of actual caking capacity.It is impossible to determine it by direct methods as all the samples hadbeen chosen in the zone of oxidation.That is why it was used the method of studying of optical peculiarities of "baked coal".It represents the visual determination of coal vitrinite character,heated in retorta or plastometric glass up to temperature of 700° with speed of 3° per min.As a rule, vitrinite of thermo -methamorphised coals,which belong by formal signs of methamorphism extent to sub-stations -"F_h","$C_{m\,1}$",or the higher one,which after the heat remains the same izotope as well as in gas coal.Thus,the above said speaks for the fact, that coals sharply differ by properties from real fat or coking coals.

From the review of the coal-bearing concerned territory one can make the following main conclusions :

I.Coals of the basin are Carbonaceous,humic.

2.With the fullest content of coal is the Darrai-Suf area,and within its limits stripe which stretches to North-East from the Darrai-Suf valley up to the Kara-Kotal deposit inthe South-East,having the extension about 45 km with width in 6-7 km(the Darrai--Suf-Kara-Kotal stripe).In this stripe will be concentrated the main reserves of the Carbonaceous of the investigated territory.

3.At the area of west end of the Darrai-Suf-Kara-Kotal stripe/The Shabashek deposit area/ thank to the most favourable tectonic and climatic conditions the coal accumulation took place all the time ,beginning with Upper Triassic to Upper Jurassic including. Because of this ,in comparison with the other areas was formed a lot of coal beds (up to 45) with the biggest thickness.

4.The Puli-Khumri and Chal-Namakab coal-bearing areas because of specific tectonic conditions were characterised by less favourable conditions of coal accumulation ,which had sharply episodic character. Here were formed a lot of coal beds of comparatively small thickness (Low Jurassic - 2-3 beds,,Middle Jurassic - 2-3 beds, the basement of the Upper Jurassic - 3-4 beds).

5.The Saigan-Ishpushta coal area is notable for more unfavourable conditions for coal accumulation.The known here deposits (Ishpushta-I and Ishpushta-II) and coal manifestations(Barfak,etc.)cannot be the base for coal production industry.

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6.Themark composition of the Carbonaceous of the investigated territory is monotonous. The most part of them,except the Chal-Namakab area, belongs to mark G and only a little part to mark D(long-flamed),(GOST 8I80-59).

Coals of the Chal-Namakab area have high methamorphism extent Marks F,C,EC and E). However in spite of the fact that methamorphism of coals is of marks F and C and their favourable petrographic composition their greatest part as the result of thermal actionhardly will be available for receiving metallurgic coke without graiding of chikhta.The exception is the Bazarak coal,which can be used for independent coking.

Emanciated coals can be used only as energetic fuel.

7. The most interesting coal areas in North Afghanistan are the coals of the Upper Triassic and Low Jurassic in the North-West of the Darrai-Suf coal area (Shabashek, Regbulak,Dakhnitor,Lela).The Carbonaceous of this age having favourable composition can be referred from to coals transited from G to F (to marks G_{I6} or F_{I3} according to the Donetsk classification GOST 8I80-59).

Coals of the described deposits are humic,which were formed for the sake of the accumulation of high plants.The accumulation took place by autochthonous way under conditions of stagnant flooded swamps,situated in intermontain valleys,and in the Chal--Namakab area in piedmont trough. Sometimes were conditions,which are typical for semy-dry and dry swamps.As the result of new positive tectonical movements and denudation of overlapped deposits the coal strata at some areas were brought out to modern day surface

Below is given the consistent description by coal areas of most considerable deposits and coal manifestations of the Carbonaceous.Inconsiderable coal manifestations, having no practical meaning are given at the catalogue of deposits attached to the report.

METHODICS OF SEARCHING WORKS FOR COAL

The searching works were carried out together with the geologo-surveying works. At the areas of distribution of coal deposits took place the concentration of geological routes with the aim to find out coal beds and general perspectives of coal deposit area. At the known before deposits and areas with exceeded coal-bearing capacity on the base of concentration of routes were composed scheme geological maps (scale I: 50 000) and was carried out the detailed description of section of coal-bearing strata.The founded coal beds had been recovered by fine trenches,was carried out their description and sampling.

Thus, geological structure of the most coal-saturated areas is described in detail.

Mainly, took place the sampling of coal beds out of the surface trenches and small holes,which came out from zone of oxidation and weathering.A small part of them wa taken out of underground mine working in the process of exploitation of the Dakhnitor and Karkar deposits,as well as out of prospecting adits of the Shabashek and Sarry-Assia deposits. All the samples were handed for chemical and petrographical study at the laboratory of the Departament.

The main method of coal bed sampling is trenching.When there is simple structure of bed, the trench took place by the whole its thickness from roof up to soil.By the thick beds and beds of complicated structure trench samples were chosen by separate coal bands (Plate-differentiated sample)

The trench section while sampling the coal beds in trenches was accepted as 3 x 5 cm In underground workings - 5 x 7 cm.The length of trench of plate-differentiated sample was determined according to thickness of coal bands and ranged within the limits from 0.2m up to I.00 m.All the samples by normal thickness of coal beds. Before the sampling took place planation and documentation of the face and trench marking.Then near the face was stretched a tarpaulin,on which was cut out the coal.In taking samples the rock interbeds less than 2 cm were included in sample.

In some cases when in sections was established a lot of coal beds were taken the lump samples.The lump samples were chosen also at the places where coal beds had been insufficiently recovered by workings.Thelump usualy was taken of 20 x 20 cm out of the most typical for coal bed band.The taken samples were packed in pots and were directed to the laboratory of the Departament.The sample treatment took place in the laboratory in accordance with GOST 9080-59.The final sample weight was counted by Chechet formula $Q = K^2$, where Q- is sample weight in kg;K-unevenness element coefficiency; - element diameter in mm.

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Together with the sampling at technical and other types of analysises was taken coal with weight of 3 mm for petrographical investigations.The determination of chemical parameters took place with accordance with the accepted in the USSR demands (GOST 6379-59;8606-6I; 6383-52; 6382-52; 2I60-62).

For controlling were carried out the control analysises by deceiphered samples. As the result of the determination of control samples was established good correlation of analysises which is not beyond the possible divergence.

With the aim to find out the coking marks we carried out some special petrographical and technological studies of coal. In connection with the indexes of the preceeeding investigators about the possible occurrence of such coal sort in the Chal--Namakab coal-bearing area (Chal,Zamburak deposits) coals of a number of deposits (Chal,Bazarak,Darrai-Kolon,Namakab,Roshag and Zamburak) had been submitted to more detail study.The general results of the petrographic and technological studies and the methodics are said below.

Petrographical coal investigation,carried out in I966 had been built to desipher the speci of coal methamorphism of each coal-bearing area.In connection with this the methodics of work had been changed and added by a number of non-standard determinations accepted at a number of laboratories in the USSR.

During the quantity-petrographic analisys of organic coal mass to melt components which condition the caking capacity,referred only the Vitrinite group ( ).

The determination of methamorphism coal took place by polished section-brickets o crushed coal in glicerine immersion.Here was used the method of double polished sectio according to Travin A.B.,which represents the comparison of colours of vitrinite and standard spores and investigated coals.As a standard they used regionally the methamorphised coals of the Karaganda coal basin of the following sub-stations:"Gh",Fc", "Fh","Cm","Cc". These sub-stations in reflected light have the following features:

"Gh"-gas high-methamorphised.The spore shells are black and brown-black, Vitrinit and semy-Vitrinite contrasts are extremely distinctive.Vitrinite is dark-grey with sli brown tint.

"Fm"-fat middle-methamorphised.The spore shells in polished sections with glicer immersion are grey with brown tint, Vitrinite and and spores contrasts are very distir ctive.Vitrinite has grey colour.

"Fl"-fat high-methamorphised.Spores are characterised by light-brown tint of grey colcur.The Vitrinite and semy-Vitrinite contrasts are very poor.

"Cl" - coking little-methamorphised.Spores are grey with ash tint,often problematic.Contrasts between the Vitrinite,Semy-Fusenite and Fusenite are very distinctive.

"Cm".-coking middle-methamorphised.Spore shells in ordinary reflected light are not seen.Contrasts between Vitrinite and Fusenite are slightly poored.Vitrinite is light-grey with bluish tint.

As the coals of the majority of the Chal-Namakab coal deposits had been submitted to thermal action,special attention should be paid to micropetrographical signs. In accordance with literary data and factual observations they are the following:

ordinary reflected light	; polarizated reflected light
I.Milk-white tint of Vitrinite	I.High anizotropic fusene-like formations.
2.Fine irregular porosity on the Vitrinite grains.	2.Fine high anizotropic (graphitisised?)margin around fragments of semy-fusenite of micrinite.
3.Uneven"wrinkled surface of Vitrinite grains.	3.General anizotropy of Vitrinite grains.

By comparison of the investigated coals with the standards had been established, that in the Chal-Namakab area there are no methamorphised coals ~~than~~ below than "Fh" and in the Darrai-Suf and Puli-Khumri areas ean be met ccals which are methamorphised not higher than sub-stage "G . According to graphic of dependence of petrographic and technological parameters,which was compiled for the regionally methamorphised coals of Kuznetsk basin (USSR),coals of low methamorphism cannot have caking capacity more than I2-I3 mm (fig.III).

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The latter is distinctively confirmed by technological tests of the Shabashek coals With worse composition typical for the Ishpushna coal deposit,the index of caking amount less than 6 mm.

From the other side,coals of the Chal-Namakab coal-bearing area,which are put on th the same graphic had to find out the higher caking capacity (up to 20-22 mm),if their methamorphism degree is conditioned by regional reasons.But for the majority of the deposits of this area petrographically was proved thermal(in some cases,dynamo-thermal) character of methamorphism coals.For such type of coals very important is the estimation of actual caking capacity.By direct methods it is impossible to determine it,as all the samples were taken in the zone of oxidation.That is why was used the method of study of optical peculiarities of " baked coals".It represents the visual determination of coal Vitrinite character,heated at retorta or plastometric glass up to temperature 700° with speed of 3° per minute.When reaching the requisite temperature the received semi-coke is cooled and out of it make polished section,which is seen in polarizated light. The observing picture of " ripples" of plastic mass of Vitrinite compare for gas,fat,coking emanciated methamorphism stage,which are characterised primarily technologically.Coals of different marks are very specific.

All the above said shows that first of all that thermally-methamorphised coals of the Chal-Namakab area originate from gas and long-flamed coals of low caking capacity; secondly, approves their sharp varaity by features from the actually fat or coking coal

Preceeding from the review of coal-bearing concerning territory one can make the following practically important conclusions:

I.The most coal-bearing area is the Darrai-Suf coal-bearing area,and within its limits the belt which stretches from the Darrai-Suf in the West up to the Kara-Kotal deposit in the South-East,the extension is about 45 km with width 6-7 km.In this belt the Darrai-Suf-Kara-Kotal will be concentrated the main reserves of the Carbonaceous at the investigated territory.

2. 2.At the area of the west end of the Darrai-Suf-Kara-Kotal (the Shabashek deposit area) thank to the most favourable tectonic and climate conditions the process of coal accumulation took place regularly,starting from the Upper Triassic up to Upper Jurassic inclusively.Thank to this,in comparison with ather areas was formed the most number of coal beds (up to 45) with the largest thickness.

3.The Puli-Khumri and Chal-Namakab coal-bearing because of specific tectonic conditions were characterised by less favourable conditions of coal accumulation,which had sharp episodical character.Here was formed a few coal beds with comparatively small thickness (the Low Jurassic -2-3 beds,Middle Jurassic -2-3 beds,the basement of the Upp Jurassic -is 3-4 beds).

4.The Saigan-Ishpushta coal bearing area is notable for the most unfavourable conditions for coal accumulation.The known here deposits (Ishpushta-I and Ishpushta -II) and coal manifestations (Barfak and others) of the coal production industry.

5.The mark composition of the Carbonaceous of the investigated territory is monotonous.They refer mainly,to sub-stage "Gh; in some cases can be mentioned the transited variaties to "Gl" and to "Fm".The possibility of finding the regionally-methamorphised Carbonaceous coals of marks "F" and "C" in the Chal-Namakab coal-bearing area is not approved yet and remains doubtful.The high methamorphism of coals of this area is conditioned ,mainly,by thermal action of intrusions.Such sorts of coal cannot produce coke.

6.At the present stage of the investigation of the coal-bearing squares in North Afghanistan practically the most interesting for search of caking marks of the Carbonaceous coals are the Coal-bearing deposits of the Upper-Triassic and Low Jurassic in the North-West of the Darrai-Suf coal-bearing area (Shabashek,Regbulak?,Dakhani-Tor, Lela).The carbonaceous of this age under favourable composition can be referred to coals of the transited stage from "Gh" to "Fm" and ,may by ,to stage "Fm".

Below is given the sequential description of the most important deposits and coal manifestations of the Carbonaceous.The small coal manifestations of no practical meaning are given at the catalogue of deposits and manifestations of useful mineral attached to the chapter and at the chapter text are not described.

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DEPOSITS AND COAL MANIFESTATIONS OF THE DARRAI-SUF COAL AREA.

Lela-I and Lela-II deposits (I,Ia,Ib,2)

The Lela-I deposit is situated in I3-I5 km to South-West from the Dakhani-Tor mine upwqrds along the Khakhar-Dekh river in the mouth of Lela sai,at its slope,above the settlement of the same name.From the Dakhani-Tor deposit there is a good horse pass, which can be changed into the available form auto transport.

The deposit is confined to the northern wing of anticlinal,the axis of which passes in the North-East direction along the Lela river and,apparently, complicated by the lineal washing out,by which the north-West block is relatively elevated (fig.II2).The deposit area is complicated by the deposits of the Regbulak suite (Low Jurassic)of the "low part" and "upper part" of the Shabashek suite (middle Jurassic) and Bashek sui (upper Jurassic) occurring apparently conformably and having monoclinal dipping to the North-West under angles 40-45°.The Jurassic deposits in the upper part of the slope with angle unconformity are overlapped by the flat lying deposits of the Cretaceous-Paleocene.

At the Lela-I deposit the coal-bearing deposits are the deposits of the Regbulak suite and "upper part" of the Shabashek suite.

Coal beds connected with the deposits of the Regbulak suite come at the surface in north-east wing of anticlinal,in the pouth part of the left bed of the lateral tributary of the Lela river,near the low end of village Roshagi-Bolo(I2).The outcrop is confining by strike (about I2 m),but recovers the fullthickness of complicated coal bed with thickness of coal 2.25 m.The bed structure is shown at the fig.II3(exp.6388). Another bed of the Carbonaceous is situated approximately in I00 m above by section from the described one and is cropping out somewhat above by lateral tributary.It has simple structure and thickness of 0.35 m.The beds here are crumpled into small foldings and have dipping to the South-East under angle of 20°.Coal beds connected with"upper part" of the Shabashek suite,having thickness in 344 m,were discovered over village Lela,in 650-700 m above the valley bottom.Here are established 4 coal beds (fig.II3). The lowest bed in I40 m above the basement of "upper part" of the Shabashek suite has complicated structure and thickness (by coal) -0.78 m (exp. 3994). The second bed lies in 60 m above by section from the described one.It has also complicated structure and thickness (by coal) I.55 m(exp.638I). The third bed occures in 40m above the second,having simple structure and thickness about I.10m (exp. 6380).The forth bed lies above the third one in 60 m,has also simple structure and thickness abou I.50 m (its basement is covered under landslide).The mentioned coal beds with intervals (because of the turf slopes) are traced in South-West direction,approximately at 2.5 km Their thickness ,apparently,is submitted to essentional changes up to complete pinching out (for example, low bed).The second from the bottom bed at the distance of one km (to South-West) has thickness (by coal) in total 0.80 m (I8).

The lela-II deposit is situated over along the Lela valley from the Lela -I deposit in 5 km,at the left slope of the valley (fig. II2).From the Lela-I deposit there is good horse pass.The deposit area is composed of "low part" and "upper part" of the Shabashek suite,Bashek suite and Cretaceous-Pale cene rocks.The tectonics of the deposit is the same,as for the Lela-I area.The difference is that here north-eastern wing of anticlinal is complicated by several fractures,which have different strike (sub-latitudinal,Sub-meridional) and steep dipping.By these fractures can be observed shiftings both,by vertical and by shiftings of trough character with amplitudes up to 250 m.These fractures,especially very often at the East wing of the deposit single out the Lela-I from the Lela-II.

At the Lela-II deposit the "upper part" of the Shabashek suite,having thickness in 360 . 0 m, amounts 9 beds of the Carbonaceous coal.The beds occupy the following levels ,going from the basement of the "upper part" of the Shabashek suite.

I) in 32 m from the basement bed of simple structure,thickness .....0.45 m;
2) in 56 m above the preceeding bed,bed of simple structure,thickness....20 m;
3) in 24 m above the preceeding bed,bed of simple structure,thickness....25 m;
4) in I6 m above the preceeding bed,bed of simple structure,thickness....60 m;
(sample 7I56-2);

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5) in 38 m above the preceeding bed,bed of simple structure,thickness...I.IO m; (sample 7I55-2);
6) in 40 m above the preceeding bed,bed of simple structure,thickness 0.35 m;
7) in 64 m above the preceeding bed,bed of simple structure,thickness I.80 m; (samples 7I53-2 & 7I53-2a);
8) in 44 m above the preceeding bed,bed of complicated structure,thickness 0.95; (sample 7I5I-4);
9) in 80 m above the preceeding bed,bed of simple structure,thickness 2.80 m; (samples 7I50-2 & 7I50-2a & 7I50-2b).

The Carbonaceous coals in the numerated beds are shining,sometimes striped because of the shining and half-shining variaties,fragile,heavily weathered,often with the tint of ferrum oxide by the jointings.

The numerated beds of coal as well as at the Lela-I deposits are of non-persistent thickness.Their dipping to north-west,under angles 50-55°.The whole coal-bearing band by strike is traced at the deposit area at I.5 km.To South-West it is covered under detritus and to North-East is cut by earlier observed fractures.In spite of this fact,in the mixtured blocks one can also observe some coal beds and in more detail prospecting works to correlate them with coal beds of the Lela-I deposit.In this case the total extension by strike of the coal-bearing band of Lela-I and Lela-II will be of 5.0 km.

In the South-East wing of anticlinal (left slope of the Lela valley) the coals Carbonaceous cannot be seen.In a number of places at the areas of land-slides is seen talus,which is sure to point out at the fact that here are the beds of the Carbonaceous coals covered under detritus.

The designing in the Lela-I and Lela-II deposit area the perspective square (I)^{x} in 6 km^{2} is recommended for detailed search-prospecting works.It envelopes partially and South-East side of the valley;to the South-East -goes beyond the limits of the investigated territory.

Orientally the reserves of only Middle-Jurassic coals of the Lela-I and Lela-II deposits can be estimated in I2-I5 mln.tons.

Besides the described above beds,according to data,received from the natives,to the South-West,higher the Lela current and in the adjacent valley of the Bazarak river beyond the limits of the investiga ted territory there some outcrops of coal beds.

According to microscopical study the Lela coals can be fragmented,with a lot of big lenses of structural semy-Vitrinites.At the same time the Lela-is is the only deposi in Afghanistan,which contains in the coal the semy-vitrene in the form of filiform veins penetrating the helificiated unic mass.

The matter component of coals of the Lela deposit is notable for low content of components of Vitrinite groups (5I.6-80.4 in average -65%).A great quantity of component of Semy-Vitrinite group is typical -from I5.I up to 40%,in average 26%.Components of Fusenite group are in samples in small quantities from 3.0 up to 8.8%;only in sample 7I5 - the Fusene content is increased up to 22.5% for the sake of Fusene. The sum of emanciate components is high enough -up to 34%,in average 26%.

Methamorphism specially was not determined,but by the colour of microspores and helificiated mass it can be counted to be equal the Shabashek and Dakhani-Tor,that is II_2 -gas middle-methamorphised coals.

Coals of the Lela deposits by matter composition are very close to coals of the Dakhani-Tor.The difference in the content of components of groups of Semy-Vitrin Fusenite and mineral mixtures is conditioned by facial differences,when in the Dakhani-Tor prefered conditions moveable,causing the considerable detritus of mineral mixtures and Fus nite fragments,and in the Lela the conditions of the formation of turf deposits were more stable,the detritus played inconsiderable role and very widely was developed the local oxidation of organic remnants.

The base of mineral mixtures of the Lela deposit represent minerals of clay group. Their quantity changes in different samples from 0.80 up to 29.3 %,in average 7.9%. Almost always in all samples there is quartz in the quantity of 0.3-I.I % (in average 0.6 In some samples exist ferrum hydro oxide.Their quantity -is 0.5-I.5 %.In one of the samples is found calpite in small quantities.

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The ashness of the investigated changes from II.0 up to 20.0 %.Only in one sample with big quantity of clay ashness is 37.2%. Enrichment capacity of the investigated coals is light and medium, and only in sample with high ashness is difficult.

All the samples,chosen at the Lela deposit are strongly oxidated.Their moistence changes from 9.8 up to I5.9 %.By the ashness the investigated samples should be referred mainly, to group of low-ash (A^c change from 2.4 up to I4.25 %).Only one sample - 7153-2--of high ash (A^d - 36.06 %). The injection of gas matters changes from 32.8 up to 38.76% and depends on microcomponent coal composition.

Thus,to the content of microcomponent of Vitrinite and Leiptinite in 53-63% corresponds the injection of gas matters from 33-34%,37-39% of injection of gas matters corresponds ~~the~~ to the sum of Vitrinite and Leiptinite in 63-81%.

/ see table in Russian report,at page 502./

Dakhani-Tor deposit (3)

The deposit is situated in 30 km upwards by the Darrai-Suf river from the village of the same name,at the junction of the Chakhar-Dekh and Sary-Tor rivers.According to administrating division the deposit is situated at the territory of Samangah province. The Dakhani-Tor deposit is connected by roads with villages of the Darrai-Suf,Mazari--Sharif and Aibak.It is the most important and considerable in North Afghanistan.Before were carried out the prospecting works and were calculated the oriental reserves,which amounted I0 mln ton.At present time are carrying out the preliminary and exploitation works.

The deposit area is composed by the deposits of the Regbulak suite,"low part" and " "upper part" of the Shabashek suite,forming the southern wing of sublatitudinally stretched anticlinal.The deposit of the Carbonaceous is connected with the deposits of the Regbulak suite (low Jurassic).Besides, the small coal manifestations of no practical meaning,are observed in "upper part of the Shabashek suite(3a,3b,3c,3d).The deposits of the Regbulak suite at the deposit area have the dipping to the South-West under angle 3[illegible] Coal-bearing strata is represented by the interchanging of dense clayes,coaly dense clay aleurolites and sandstones. Dense clayes and aleurolites contain beds of the Carbonaceou The sandstones mainly are fine-and middle-grained,sometimes with interbeds and lenses of gravelites.The visible thickness of coal-bearing strata is about 400 m.The beds of the Carbonaceous are confined approximately to its middle part.The total visible thickness of the Jurassic deposits in the deposit area is I260 m.

At the deposit were found two beds of coal with working thickness.The coal beds lie closely.Between them is situated bed of sandstone with thickness of 6m,having in the soi and roof coaly argillites.The total thickness of the band of dividing rocks is ~~MXXX~~ I0-I Both beds of the Carbonaceous are of complicated structure.

The low bed is the best and represented by two or three coal bands,being divided by rock interbeds (fig.II3).Its thickness ranges from 2 upto 3-3.5 m.It is necessary to point out that the rock interbeds are not stable and in some faces they disappear or vise versa,they increase in their thickness,sometimes up to 0.50 m.

The upper bed is also of complicated structure and represents the interchanging of coal interbeds from 0.02 up to 0.35 m,coaly dense clayes with thickness up to 0.03-0.05m and dense clayes-0.03-0.0I6 m.The total thickness of the bed reaches 2.32 m.

Coal beds are traced by strike at 2.5-3 km and by dipping at I00-I50 m.

Besides the described coal beds in the deposit area there are some coal beds of little thickness,which lie lower and above the described.Because of inconsiderable thickness they do not represent practical interest.

Among the deposit coals dominate half -shining coals,which are contained from 0 up to 95%,in average 5I %.More than a half of half-shining coals is represented by striated variaty,not very clear,with ash base and big lenses of fusene.Rare are met thin-striped ,fine-lense-like striped and striped variaties with ash base.

The following,by quantity and frequence of occurrence,dull ash coal-striated and rare-striated.In average they are about 30%.

About 7% count the shining coals,in most cases the clarain indistinctly striated. Rare are met the shining Vitrene coals.

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Half-dull coals are met in one sample in the quantity of 40% and they are represented by the foliated and lenses-like striped, sufficiently ashed variaeties.

In the coal mass of samples, in spite of the fact of the differentiated sampling are met the rock interbeds from 0-20%. They are represented by coaly argillites with rare strates of Vitrene, sometimes crumpled up to flaky state.

Sometimes are met the interbeds of cuticle foliated coal.

The matter composition of coal of low bed is characterised by medium content of all microcomponent groups (see table), with sum of emanciated components in average of 21%. Coal of "upper bed" has the lower content of Vitrinite group components-50.4% and the higher -of Fusenite group components -23.4%. The sum of the emanciated components in average -34%.

Methamorphism of the Dakhni-Tor coals is determined in comparison with standards of Pechora coal basin as II_2 - gas medium-methamorphised.

At the laboratory of petrology of coals of IG and NGI were carried out 4 determinations of indexes of reflected capability (IO%) of the Dokhni-Tor coals, which according the data of the laboratory is equal to 80%.

Mineral admixtures in the Dakhani-Tor coals are represented by clayey minerals, quartz, pirite and ferrum oxide, calcite, ciderite and gypsum.

The majority of clayey minerals is gathered into lenses and interbeds. That is why comparatively easy it goes from during the enrichment. Quartz is about 0-0.7% in the form of small rounded grains in clayey matter and rare in organic coal mass.

Pyrite is met in small quantities, sometimes is oxidated up to ferrum oxides.

A small quantity of Calcite is met in the middle part of low bed, and Ciderite- in the upper part of the upper bed. In the centre of the bed can be observed considerable quan quantity of Gypsum -2.2%.

Ashness of the investigated samples by petrographic study change from II.4 up to 28.6 %. In average for low bed ashness amounts I3.4%, and for upper bed-21.4%.

Enrichment by beds is medium, by separate samples from easy to difficult. The concentrate outcome with ashness up to IO% with fine crushing of coal amounts 64-94%, and with enrichment of ordinary uncrushed coal- 20-90%.

According to technical analysyses the moistness of coal low bed is 2.16-2.87 %. Ashness of different bands changes from IO up to 26%. In average the bed is represented by ash coal. Injection of gas matters (Y^g) changes from 33.6 up to 37.8 %. The character of coking button is caked.

The moistness of the upper bed of the Carbonaceous is 2.74-4.23%. The injection of gas matters amounts 30.56-33.65%. The low injection of gas matters is explained by the worse microcomponent composition. The coal ashness changes from 22.4 up to 28.3 % that is the coal bed belongs to group of high-ash.

Technical analysis of coals is given at the table, at page 508, Russian report.

TheDakhani-Tor can be used in coking. The enriched unoxidised coal can produce coke with index of strength of remnant in the drum 245-265 kg.

~~XXXXXXXXX~~ Sary-Tor coal manifestation (4)

It is situated in 8 km to the East from the Dakhani-Tor deposit upwards by the Sary-T -Tor river. From the Dakhani-Tor deposit here goes horse pass. Here in I km above the Kasaban river mouth, in the right side of the valley are exposed the Jurassic coal-bearing deposits of the Regbulak suite and overlapped of "low part" of the Shabashek suite, The deposits of the Regbulak suite are represented by the interchanging of bands of sandstones, gravelites, sometimes intercoming in fine-pebble conglomerates, aleurolites and big bands of dense clayes and coaly dense clayes, having the dipping to NE with angle of $25-30^{\circ}$.

In this strata are recovered two beds of the Carbonaceous coal with working thickness. These coal beds are situated at the same stratigraphic level that the Dakhani-Tor deposit beds (fig II4).

The thickness of the low bed is I.IO m. In its middle part there is an interbed of dense clay with thickness of 0.02 m.

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The upper bed lays in I0 m above by cut and reaches thickness of I.04 m.The bed of complicated structure consists of two coal bands (0.07 and 0.97 m),divided by rock interbed of 0.I5 m.The practical value represents the low band of coal with thickness of 0.97 m.The upper interbed of coal represents the false roof.

In the structure of coal beds take part half-shining and dull coal variaties.

Half-shining coals are represented by striated-striped and rough striated varia-ties from 70% up to I00 %.

Dull ashed fine-striated coal there is in the form of solitary interbeds.

The matter composition of samples is different.In the upper bed is observed the high content of Vitrinite group and the low -of the ather groups.The sum of emanciated components -is I2%.

In the low bed there is too little of Vitrinite-54% and much of oxidised micro-components.Sum of emanciated components - is 38%.

Methamorphism of coal is determined as I_3 - long flamed high-methamorphised.

See Russian report,page 5II.

The high content of moisture shows at the coal oxidation.

By ashness coals should be referred to low-ash.They can be used as energetic fuel.

Besides the described above beds in the area of coal manifestation there are some areas with soot vysypka,showing at the possibility of finding here other coal beds.

In spite of the fact that the coal beds of coal manifestation Sary-Tor because of considerable turf surface are traced only at 20-30 km,this coal manifestation is worthy of further more detail search-prospecting works,as for example ,the Dakhani-Tor deposit.

West Garmak deposit (5,5a,5b,5c).

The deposit is situated in 3.5 km to the NE from the Dakhani-Tor coal deposit, lower by the Darrai-Suf river,in its right tributary Darrai-Garmak.

The coal-bearing strata of the West Garmak deposit is correlated with coal-bearing strata of the Shabashek coal deposit (Shabashek suite of Middle Jurasic).It is formed by dense clays,aleurolites with rare bands of middle-grained,often calcic sandstones.

For the deposit is typical the existence of steep,often laid foldings and small fractures,accompanying the main fracture,passing to NW from the deposit.

In the coal-bearing strata are established I0 beds of hard coal.9 of them are of working thickness from I.05 up to 8.30 m.4 beds have the complicated structure.In the thick bed (8.3 m) are singled out the coal bands with thickness up to I.8 m which can be accepted for independent beds of simple structure.

Below is given the description of coal beds (fig.II5).

Bed I-of simple structure,is represented by unic half -shining coal.Thickness of bed is I.20 m.In the roof and sail-dense clays.

Bed 2 -of complicated structure,is represented by half-shining and half dull variat ties. In the bed there are 5 rock interbeds with thickness from 0.0I up to 0.03 m.In the roof-aleurolites.In soil-greenish-grey clays with coal interbed with thickness of 0.0I m.The total thickness of coal bands in the bed is 2.9 m.

Bed 3 -of simple strycture,is represented mainly by half-shining coal and only in the the low part 0.25 the coal is dull.In soil and roof there are dense clays.Thickness of the bed is I.55 m.

Bed 4 - of complicated structure and is represented by three coal bands (0.35; 0.40; 0.40 m) divided by rock interbeds 0.30 and 0.50 m.The total thickness of bed is I.95 m.The sum thickness of coal bands in the bed is I.I5 m.The bed hardly can be the object of production,as the rock interbeds have considerable thickness.

Bed 5 -thick complicated structure,consists of 4 coal bands I.80;I.04;I.90;I.20 m divided by rock interbeds (I.20;I.00 and 0.20 m).The upper coal band with thickness of I.8 while treatment can be the independent bed.The second coal band (I.00 m) represents the fine interchanging of dense clays and coal (by 0.03 m) and because of high ashness is of no practical importance. The two low coal bands I.90 and I.20 m divided by clay in interbed of 0.20 m represent practically one bed of complicated structure.

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The total thickness of bed 5 amounts 8.30 m.The sum thickness of coal bands is 4.90

Bed 6 has thickness up to 0.50 m and it is of no practical interest because of its small thickness.

Bed 7 -is of simple structure is represented byunic half-shining coal.Thickness of it is not determined ,but it is supposed not to be thick , ot less than 1.50 m.

Bed 8 -is of complicated structure,consists of three coal bands (o.I5;0.I5 and 0.30 divided by rock interbeds 0.30 m and 0.15 m.The total thickness of the bed is I.05 m The total thickness of coal bands is 0.6 m.Because of complicated structure and rock int interbeds the bed is practically of no importance.

Bed 9 -with thickness of 3.00 m in the low part has argillite interbed with thickness of 0.10 m.Coal is half-dull and half-shining.In roof and soil there are argillites.

Bed 10- lays among sandstones.The bed is of simple structure. The total thickness is 1.20 m.

The most difficult for treatment of the deposit will represent the small folding and fractured faults.

From the described deposit ,upwards by the Darrai-Garmak valley,bed outcropps of co coal are traced almost without interval up to pass.Thus, old openings were established in I.5 km above the main deposit (5-b) and 2.5 km under the pass (5-c).The coal beds are traced and lower by the Darrai-Suf valley more than at I km (5a) from the main place of outcome,where there are also openings with recovered beds with thickness from I.5 up to 2.5 m.

Thus, by strike in the Darrai-Garmak valley the coal-bearing deposits are traced at 3.5 km.

The coal-bearing strata of the WestGarmak deposit is traced to the East up to the East Garmak coal manifestation,composing with it unic deposit.In connection with this the question of quality of coal of the West Garmak deposit and the East Garmak coal manifestation,as well as some practical questions will be considered after the description of the East Garmak coal manifestation.

East Garmak coal manifestation (6,6a,6b).

It is situated in 45 km to the South-West from village Chikhil-Dukhtaren,in 4 km to the East from the West Garmak deposit and ,practically, represents its extension by strike to the East. The coal-bearing strata is composed of the same rocks that on the West Garmak deposit,but the occurrence is more quite,though steep.Coal beds lay in the w wing of overturned anticlinal folding and have azimuth of dipping of 180 ^{o} under angle of 80-85°.

Here in 3 km above the Garmak river mouth are recovered 4 coal beds and a number of interbeds of small thickness.(fig.II4).

Bed I -is of complicated structure,consists of three coal bands (0.30;0.22 and 0.32 divided by rock interbeds (0.02 and 0.14 m).Coal -s half-shining with interbeds of the shining.Soil and roof - are dense clays.The total thickness of the bed is I.00 m.The sum thickness of coal bands is 0.84 m.

Bed 2 consists of two coal bands with thickness of 0.53 and 0.55 m with the dividing interbed of dense clays of o.o4 m.Coal of the upper band is mainly half-shining,of the low -is shining.The total thickness of coal mass is I.08 m.In soil and roof there are dense clays.

Bed 3 -is of complicated structure,consists of 3 coal bands (0.45;0.27;0.7I m), divided by rock interbeds (0.08 and 0.04 m). The upper coal band is represented by high ash coal or by very fine interchanging of coaly dense clays and coals.The total thickness of the bed is I.55 m.Thesum thickness of the bands is I.43 m (including and the upper ash band).In the roof and soil of the bed there are fine-bedded aleurolites with bad flora remnants.

Bed 4 -is of simple structure with thickness of o. 45 m.It is composed mainly by dull coal.In the roof of the bed in the dense clays can be observed fine coal interbeds.I In soil there are dense clays.Here ,near bed 4 is observed the interbed of half-shining c coal with thickness of 0.25 m.

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Coal-bearing deposits are traced and lower by the Garmak valley.Thus, in 1.5 km from the described coal manifestation among the coaly dense clays are exposed about 6 beds of coal with thickness from 0.15 up to 0.45 m (6a).In the adjacent to the East Changau sai,in its left tributary Darrai-Kazhak(6a),are exposed coaly dense clays and aleurolites with interbeds of shining coal with thickness up to 0.10 m.Apparently, there are interbeds of more thickness,but they are covered with down old openings. Here the rocks have angle 60-65° to NE.

In the structure of the West Garmak deposit beds and the East Garmak coal manifestation take part shining ,half-shining,half-dull and dull coals.

The shining coals can be met only in separate beds and their quantity changes from 10 up to 50%.They are represented,mainly, by indistinct striated clarain variaties. Vitrene coals are met very rare and in small quantity.

Half-shining coals are the basic of coal beds (from 50% up to 100%). Among them are mentioned striated and striped variaties.Dominate striated and indistinctly striated coals with solitary Vitrene lenses. Rare are met striated-striped low ash coals with numerous Fusene lenses,lenses-like-striped and frequent-striped with fusen base,striated fine-striped with ash base and homogenous with metal-like shining lustre.

Among the dull coals are mentioned ash striated variaties,large fusen lenses and sometimes are met dull homogenous coals.

Substance composition of coals is notable for high percent of Vitrinite group components (from 71.6 up to 92.2%).The Semy-Vitrinite group components and Fusenite are preserved in comparatively small quantities from 1.8 up to 15.8%.Leiptinite in different quantities from 0-7.3%.The sum of the emanciated components is low from 6-21%,in average 14%.In coals can be met numerous remnants of bark tissue.

Coal ashness by petrographical data is not high,5.4% up to 27.4%.

Mineral admixtures in coals are characterised by the domination of clay minerals, their quantity ranges from 0.4 up to 9.5%.Almost in all samples,chosen from coal beds there is quartz from traces up to 1.4%.Pyrite is met in very small quantity.Sometimes in samples there is Calcite (from 0.3 up to 2.0%).

Coal methamorphism is determined as II_{1-2} - gas low-methamorphised.
Characteristics of coals by petrographical data is given in table(see Russian report, page 518a).

Coals of the West Garmak deposit and the East garmal coal manifestation can be used as good low-ash energetic fuel.

Taking into account that the coal-bearing strata of the West Garmak and East Garmak deposits is traced at more than 7 km here one can waite for considerable reserves of the Carbonaceous coal.

Perspective square in the area of the West Garmak and East Garmak deposits which amounts 15 km^2 is recommended for establishing the more detailed geologo-prospecting works.

Karamkul deposit (7,7a,7b).

The deposit is situated in 8.5 km to the ESE from the Dakhani-Tor and in 6 km to the West from the Shabashek deposit.

Coal beds are recovered near village Karamkul.In structural respect the deposit is confined to the northern wing of anticlinal,composed by the rocks of the Regbulak suite.The southern wing of anticlinal is complicated by steep overthrust.Stratigraphical coal beds of this deposit occupy approximately the same level as at the Dakhani-Tor.

Coal beds are concluded in the low one third (about 170 m) recovered here of the Regbulak suite deposits.This strata is represented by coaly and dense clays,with rare interbeds of aleurolites and sandstones.Thebed dipping -to the North under angle of 40-60°.Sometimes one can observe the process of overturning of beds to the South.

In the coal-bearing strata are recovered 5 beds of the coal,however by strike because of heavy turf slope,they are traced only at small distances up to 400-500 m.

Bed I -(exp.330I),(fig.114) is recovered at the right slope of the valley,opposite the end of the Low Karamkul village.The bed is of simple structure,composed of half--shining and half-dull coal variaties.Thickness of bed is 1.80 m. In the roof of the bed

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coal is ash with a considerable quantity of clayey material.

Bed 2 -(exp.4I69) is exposed also at the right slope of the valley above the Low Karamkul village.The bed is simple.In the roof and soil is mentioned the coal crumplenessx and dense clays.Thickness of the bed is 0.68 m.

Bed 3 (exp.4I68) is exposed in 60-70 m above the bed 2 (by section) at the same slope.The bed -is simple,thickness of it is I.8 m.It is composed ,mainly,by fine-striped half-shining and half-dull coal.

Bed 4 (exp.4I75) is recovered in the left side of the valley,opposite the low end of the Upper Karamkul village. It consists of two coal bands with thickness of 0.5 and I.0 m,divided by interbed of dense clays with thickness of 0.I3 m.The total thickness of the bed is I.63 m.Thickness of coal bands is I.5 m.In coal bands dominate striped half--shining coal and in very small quantity the half-dull striated.

Bed 5(exp.4I74) with thickness of 2.5 m is recovered at the top of hill,at the right slope of the valley,below the Upper Karamkul village.The bed is simple.Dominate half-shining coal variaties.In the low part of the xxxx bed coal is heavily crumpled and crushed.

In the following to the West Changau sai of the same village name(in 2 km to NW from Karamkul village)are recovered two beds of coal of complicated structure(7).

The first bed with thickness of 4.6 m is represented by very high ash coal with numerous fine rock interbeds and practically,it is of no interest,as the quantity of pure coal does not exceed 30%.

The second bed (exp.3303) consists of two coal bands (the upper 0.75 and the low 0.6 0.60 m),divided by interbed of coaly argillite of thickness 0.9 m with lenses and interb beds of shining coal 0.05-0.10 m.Coal of both bands is represented by half-shining and half-dull variaties.The total thickness of the bed is 2.25 m.Thesum thickness of coal bands is I.35 m.

Besides the described above beds in the Daut saiin I km to the East from Karamkul village there are two coal beds (7b).One bed (low) is exposed at the left slope of the valley,in 0.5 km above the Daut village (exp.4I70).The thickness of the bed is 0.66 m. The bed occurrence is overturning.Thebed dips to the South under angle of 40°.The second (upper) bed lays opposite the Daut village.Thickness of it is not determined because of caving of old opening.

The inclosed rocks are dipping to the North with angle of 40°.

Among the coals of the described beds are met half-shining,half-dull and dull species.The shining coals are represented by Vitrene variaties (from 2 up to 25%), rare are met the clarain coals (3-I0 %).The base of the beds form half-shining coals (from 20-I00%).

Among them are described:

a) striped half-shining coals (dominate) and less half-shining striated and indistictly striated.There are heavily crumpled low-ash half-shining coals;

b) half-dull striated coals there are not in all beds and their quantity changes from I0 up to 60%.Often are met crumpled variaties.

c) dull ash coals,their quantity reaches 25%.They contain usualy big fusene lenses. Dull fusene coals are mentioned in the quantity from 5 up to 20%,sometimes are represented by pure fusene coal.

The coal composition is notable for considerable percent of vitrinite group components (72.0-87,7%).Components of semyvitrinite and fusenite groups are preserved in us usual quantities -from 6.3 up to I7%.Leiptinite -from 0 up to 2.0%.The sum of the emanciated components amount I0-2I%,in average I7%.Methamorphism of Karamkul coals is somewhat highxxx lower than of the Dakhni-Tor coals and can be referred to groupII$_{I-2}$ - - gas low-methamorphised coals.

Mineral mixtures in coals are characterised by the domination of clayey minerals (from 1.0 up to I4.I%).In some samples is mentioned a small quantity of Carbonate (from 0.3 up to I.6%).In the Karamkul coals (beds 3-4) there are ferrum oxides in the quantity up to I.0%.The ashness of coals by petrographical analysises ranges from 2.8 up to 2I.0%.The specific weight is I.3I 0-I.48%.

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The characteristics of coals of the Karamkul deposit by petrographical data is given in table (see Russian report ,page 523).

As showd the technical analysises,the moisture of coal in samples changes from 8.I2 up to II.68%.The coal is heavily oxidised.The ashness of the investigated samples is within the limits from 5.03 up to 33.30%,that is to say at the deposit there are coals of all groups -low-ash,medium-ash and high-ash.The injection of gas matters chang from 37 up to 55%.The coke remnant -is powder-like.

By the results of the carried out technical and petrographical investigations the gas coals of the Karamkul deposit can be used as good energetical fuel.

Taking into account that the deposit is situated near the prospected and exploitated Dakhani-Tor deposit,it is certainly worthyof further geologo-prospecting works.

North Darvaza deposit (8).

It is situated in 2.5 km to the West-South-West from the Carbonaceous Shabashek deposit,in the area of Darvaza village,near its northern end,near a pass.The outcrop of coal beds is situated in 3 km to the South from soil road Shabashek-Darrai-Suf.

(Fig.II6)

The coal-bearing strata belongs to the low part of the Shabashek suite of the Middle Jurassic age.From the one-aged deposits of the Shabashek deposit the Darvaza area is singled out by large overthrust.As the result of this it is impossible to determine the correlation between coal beds or horizons of these two closely situated deposits without additional works.

Deposits of the "low part" of the Shabashek suite in the Darvaza area facially are notable from the developed ones in the Shabashek area-here in the section there are a lot of sandstones.

In the area of the Darvaza village the coal-bearing strata forms anticlinal folding of latitudinal strike.

In the northern wing in 0.5 km to the North from the Darvaza village is recovered a bed of simple structure.In the middle part of the bed is observed a crushness of coal with friction.The total thickness of the bed is 0.95 m.In the roof and bed soil there are coaly argillites.The bed is dipping to the North-North-East with angle of 60-70° . In connection with bad exposure by strike it is not traced.

Proceeding from the fact that by strike to the West there are some vysypkas of coal and soot and also small outcropps of low-thick coals,we can suppose that the coal--bearing strata in this direction will not diminish.

To the North-West from Darvaza village in 2.2 km in the left tributary of the river of the same name ther are coal outcropps and numerous (8) areas with soot,which show at the presence of coal beds here (8a).

One of the coal beds with thickness of I.89 m of complicated structure was recovere by trench.In the bed are mentioned two interbeds of argillite 0.07 and 0.I2 m.The sum th thickness of coal bands is I.70 m.These coal beds by vysypkas are traced by strike and further to the West from Changau sai,at the distahce of 5-6 km.

Thus, the coal-bearing stripe is the perspective one and represents practical int interest.

At this interval one can observe steep but quite monoclinal occurrence of rocks with dipping to the South with angle of 60°(southern wing of anticlinal).Therefore, the found here beds will be under more favourable conditions,than in the area of the Darvaza village,where there is small folding.

Coals of the Darvaza deposit are characterised by the domination of half-shining variaties (71%),striated,roughly striated and striated with lenses of dull ash coal with thickness up to 2 cm of indistinct striated,almost homogenous.More rare are met hal -shining striped coals,which are represented by lenses-like striped and wide-striped variaties with vitrene stripes up to 3 cm.Half-dull coals amount in average 27% and are represented by roughly-striated ,sometimes with fusene base and frequent vitrene len lenses and fine-striated variaties with clarain lenses.The shining coals are lenses--like with short lenses of vitrene up to I cm of thickness.

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Characteristics of coals by petrographical data is given in the following table: (see Russian report,page 526).

By sample No.4I62 (Darvaza South) extent of enrichment is medium,the outcome of concentrate is 8I% with ashness of 7.5%.

Microcomponent composition is characterised by high percent of fusenite group component.Sum of the emanciated admixtures is small and amount I6-I8%.The methamorphism of coals can be considered to be equal to the methamorphism of the Shabashek deposit, that is to say II$_{-2}$ -ga s medium-methamorphised.

Mineral admixtures in the Darvaza coals are represented by clayey minerals,which fo form large lenses and interbeds.

By the carried out technical analysises it was established that the oxidised coals are characterised by the high moisture.By ashness the coals belong to ash and high-ash groups.The injection of the gas is distorted because of the oxidation of samples.The coking remnant is powder-like.

Theresult of the carried out analysises by two samples are given in the following table:(see Russian report,page 527)

South Darvaza coal manifestation (9).

The coal manifestation is situated in 1.2 km to the South from the North Darvaza deposit,in the left side of the Darvaza river opposite the same village(fig.II6). Among the deposits of the Shabashek suite,in the wing of the same anticlinal,lower by se section at 200 m of the old opening was recovered coal bed.

The bed is represented mainly,by coaly dense clays and fine interbeds and lenses of shining hard coal.In the middle part of the bed is concluded the band of pure half--shining coal with thickness of 0.55m.The total thickness of the bed with coaly dense clays amounts 2.67m.However,practical meaning may have band of 0.55 m.This bed is also recovered at the opposite side of the valley.

By the relief conditions the bed is traced at I2 m. Between the North Darvaza deposi sit and South Darvaza coal manifestation because of the turf of slopes of the valley and small folding,it is impossible to determine the whole section.In some places here can be seen slopes,which are unlikely can mention bands of coaly clays or beds of the Carbonaceous coal under detritus.

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Shabashek deposit (I0,I0a).

The Shabashek coal deposit is situated in the uppers of the Chikhil-Dukhtaran -right tributary of the Darrai-Suf river.

By administration division the deposit is situated at the territory of the Darrai--Suf ujezd of Samangan province.

The deposit is connected by soil road with town Darrai-Suf,from which there is motor-road up to city Mazari-Sherif (I39 km).To the city Pul-i-Khumri there is also a motor -road,besides, from the deposit up to city Aibak(I40 km) the road is ground and it is available only during dry summer time.From city Aibak up to city Pul-i-Khumri (92 km) passes asphalt auto-avenue up to city Kabul.With ferrum-ore Khadzhigak deposit The Shabashek deposit is connected by auto-road through citi Aibak,Pul-i-Khumri and Bamian,in total ,the extension is 480 km.The shortest way,which is not available at present time for transport,passes through coal Sary-Assia deposit,Kotal-Sabzak and Kara-Kotal passes,through Madar village and further through Doab-i-Mekhzarin and Bamian villages. Thetotal extension of that road amounts I50-I60 km.

The Shabashek coal deposit firstly was investigated in the thirties by geologist Mr. Guliam Ali-Khan from the Ministry of Mines of Afghanistan and later by A.Drat. (I939)

In I940-I942 at the deposit were carried out the prospecting works by V.West(I942) In I952 he also carried out additional estimation works.

In I963-65 at the deposit were carried out geologo-prospecting works by coal--prospecting party of the Departament of Geology and Mines of Afghanistan under the guide of soviet specialists (N.S.Kudriashov,B.N.Androsov,etc,I965).In connection with this below are given only the short information concerning this deposit.

In geological structure of the deposit area take part the rocks of the Triassic, Jurassic and Cretaceous-Paleogene ages (fig.II6).Thedeposits of the Triassic (I475 m) are represented by the interchanging of band of sandstones,aleurolites and argillites with interbeds of coal in the upper part of small thickness.

Thedeposits of the Jurassic system are widely distributed and they are represented by all three divisions.Here are singled out upwards three suites:The Regbulak (low Jurassic),Shabashek (middle Jurassic) and Bashek (upper Jurassic).

Lythological characteristics of suites,in general, very monotonous.This is the interchanging of aleurolites,dense clays,coaly dense clays and more rare beds of sandstones.In all three suites are preserved numerous beds of coal.

The low -Regbulak suite (430.0 m) amounts I5 beds of coal with thickness from 0.I(up to I.00 m.There are only 4 beds with thickness of more than 0.50 m.

The Shabashek suite (450.0m) is the low productive suite of the deposit.In its section are mentioned 40 beds of coal with thickness from 0.I up to 2.98 m.I5 of them have thickness more than 0.50 and 5-more than I.0 m.

The deposits of the Bashek suite (490 m) with outwashing lay at the deposits of the underlying Shabashek suite.In section of the suite deposits are recovered I5 beds o of coal with thickness from 0.I0 up to 3.32 m. 9 of them have thickness more than 0.50 and 7 - more than I.0 m.

Thedeposit is confined to the East sinking of the Shabashek synclinal folding, having sub-latitudinal strike.The Shabashek synclinal is characterised by assymetrical structure.

The Northern wing of the synclinal is dipping to the South under angle of 40-55°. At the depth the angles become 35-45°. The southern wing is dipping to the North with angles of 35-45° and is complicated by the foldings of more low order.The wing spread by bed outcrop 7 amounts 2-2.5 km.

The large fracture faults within the limits of the investigated area were not found.Thelarge fracture fault in the area is the overthrust,which passes to the South of the investigated area deposit and,apparently, comes up to the Sary-Assia deposit.

As it was said above at the Shabashek deposit in the deposits of the Shabashek and Bashek suites are concluded I2 beds of coal with thickness of more than I.0 m (beds of working thickness). Below in table (see Russian report,page 53I)there is a characteristics for these beds.

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The average sum thickness of beds with working thickness is I8.03 m.

As the result of the carried out prospecting works by driving the surface and underground mining openings and of the drilling the holes of column mechanical boreing at the Shabashek deposit were calculated the reserves in total at sum of 73765. I thousand tons.

By categories the reserves are distributed by the following way:

Reserves by categories in thousand tons.

B	C	C_2	perspective	total
5241.5	I5482.8	23708.0	29332.8	73765.I

To the South-West from the Shabashek deposit in I.2 km, among the turf and ploughed up slope, in rain channel there is the outcome of coal bed with thickness of 2..0 m (I02). This outcrop approves the presence of coal beds in the section of the Jurassic to the South from the Shabashek deposit.

As the result of the carried out petrographical and chemical investigations of coals had been established that they belong to gas "G" and long-flamed "D"

By petrographical signes are singled out three groups of beds: the low group - -beds I-I4, middle - beds I6-26 and upper beds 27-29. These groups of beds are different by substantional composition, structure and quality.

The content of Vitrinite microcomponent groups in low group amounts 68.8-79.5%, Fusenite-7-I2% and sum of the emanciated components I2-24%.

The middle group of beds amounts Vitrinite in 76.o-86.3%, Fusenite-5.I-8.3% and sum of the emanciated components 9-I8%.

The upper group of beds has Vitrinite 59-77.6%, Fusenite I3.2-28.4% and sum of the emanciated components I9-36%.

The coal beds I,5,I6,22,23 and 29 are low ash. The average content of ashness does not exceed I2.5%. Beds 3,7 and I3-ash with I6-20%. The coal enrichment is easy and medium with crushing up to I.5 mm, middle and difficult for large classes. The yield of volatile components in poorly oxidised samples amounts in average 37-38%. The majority of coal beds is of low percent of sulphur (from 0.2I up to 0.72%) and only the coal bed 27 -is with middle percent of sulphur (I.62%).

Thepercentage of phospore is high enough -0.033-0.I03% and only coal beds 3 and I3 are of small percent of phosphore (0.004-0.I4%).

Caloric capacity of deposit coals decreases from low beds up to upper ones from 8250 up to 7620 k/cal.

Methamorphism of coals also deminishes upwards by section. Coals of the low group beds (beds I-I4) are referred to methamorphism II_2, that is to say to gas medium- -methamorphised and thickness of plastic bed from 6 up to I3 mm. Beds 26-29 are referred to gas low-methamorphised (II_I).

The low coal beds can be used for producing the coke for domain of small volume.

Thelaboratory investigations showed the availability of the Shabashek coal for producing the coke by the method of bricketting with use of the connecting material of oil origin. Coals of all beds can be used as good energetical fuel.

The Shabashek coal deposit is the most largest from the known at the present time in Afghanistan. The presence of big quantity of coal beds, comparatively simple geologic conditions and the presence of perspectives for increasing coal reserves, give the right to recommend its study.

Besides the prospected area, in 8 km to the East from the Shabashek deposit, there are some outcropps of coal-bearing Jurassic deposits between the Shabashek and Sary- -Assia deposits, which, apparently, represent the unic coal-bearing belt.

This, certainly, increases the perspectives not only the mentioned deposits, but the whole Darrai-Suf coal-bearing area too.

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Sarry-Assia deposit (II).

The deposit is situated in the uppers of the Darrai-Alma river in 0.5 km below Sarry-Assia village,at the left slope of the valley.

The deposit is connected by the soil auto-road with the Shabashek coal deposit, which is situated in 35 km to the NW.

The coal outcropps here were found in 1963 during the geological survey.

In 1965 the deposit was prospected by (N.S.Kudriashov,B.Sandzhapov,etc.,1966). In connection with this below is given the description of it in short way.

In geological structure of the deposit take part the rocks of the Triassic,Jurassic-Cretaceous and Paleogene(fig.II7).

The working coal beds are confined to the deposits of the Middle Jurassic,which at the deposit area lay monoclinally and are dipping to the West with angles of 35-75°. The coal-bearing deposits are traced by the stripe by the left side of the valley at the extension of 2-2.5 km.Besides,the most steep angles of dipping are observed in the eastern part of the deposit near the overthrust,which confines the deposit from the East.

In the northern part near Sarry-Dzhas village,the coalbearing strata by the latitudinal fault,which passes by the valley sai,is apparently ,sunk and at its strike there are some outcropps of the Upper Jurassic without coal.

In the southern part of the deposit near Sarry-Assia village there is a fault of latitudinal strike,at which the coal-bearing strata to the Southfrom the fault is sunk and at its strike here are recovered horizons of the Upper Jurassic without coal. Further in the South,in the area of the upper kishlak,near the lake, the coal-bearing deposits are recovered in the core of small overturned to the South anticlinal folding.

The deposits of the Triassic are developed in the eastern part of the deposit and they are represented mainly by the rocks of sand-aleurolites composition.Above lay the coal-bearing deposits of the Shabashek suite (middle Jurassic) with thickness of 448 m. They are represented by the interchanging of rare bands of sandstones, aleurolites, dense clays,coaly dense clays and beds and interbeds of coal.The most thick coal beds l lay in the low and middle parts of the section. In the upper horizons the thickness of coal beds considerably diminish.

Above with the washinout lays the anti-coal strata of the Bashek suite (upper Jurassic),represented by the rythnical enough interchanging of bands with total thickness of 325.0 m.In the low part among argillites are observed coaly variaties,with interbeds and lenses of coals of non-working thickness.

The Jurassic deposits unconformably are overlapped mainly by Carbonaceous rocks of Cretaceous-Paleogene age.

In productive strata of the deposit are recovered I3 beds of working thickness and a number of coal interbeds.(fig.II8 and II9).

Thickness of coal beds range from I2.87 up to 0.5 m . A lot of working coal beds lay in the low and middle parts of coal-bearing strata.

The thickness of interbeds range within the limits of 20-60 m.All the coal beds, except one (bed 9) have complicated structure and represent the interchanging of coal bands with rock interbeds.However,in beds are singled out coal bands of simple structure,reaching working thickness.

A part of the recovered beds is traced by strike at I.5-2 km.

The sum thickness of working coal beds amounts 24.7 m.

As the result of the carried out prospecting works by driving of the surface and underground mining openings and drilling holes at the Sarry-Assia deposit were calculated reserves at total sum of 5870 thousand tons (by categorieis C_1 and C_2).

Thebase of coal beds represent half-shining coals (57%),represented by striped, lenses-like-striped,indistinctly-striated and other variaties.

Unlike to coals of the Shabashek deposit coals of Sarry-Assia at 70% consist of different striped variaties.Among the dull coals (about 22%) are singled out dull, fusene,comparatively low-ash and dull ash,very close to coaly argillite.Half-dull coals (about I2%) are represented by striated,roughly-striated and striate ,with lenses of vitrene,variaties.Are met heavily crumpled half-dull variaties.The shining variaties,

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represented by vitrene belts and very sharp clarain homogenous and indistinctly-striate are preserved as 5%.

The microcomponent composition of coals is characterised by lower content of gelificated components,composing in average 69% and by higher content of components of fusenite group(in average I7%).Components of semyvitrinite group do not play considerable role,though in some beds their quantity changes from I4 up to 33% and amounts in average 25%.

In comparison with coals of the Dakhni-Tor and Shabashek deposits,coals of the Sarry-Assia deposit contain more of microcomponents of fusenite and semyvitrinite group.The methamorphism of the, is lower.than of the Dakhni-Tor deposit coals.It is estimated as the intermediate between gas high-methamorpfised and gas medium--methamorphised,approaching to the latter.

The majority of mineral admixtures in coals is represented by fine-dispersed inclusion of minerals of clay group(from 0.I up to I2.3%), by calcite (0.3-6.5%),pyrite (up to I%) and quartz (less than 0.5%).In oxidised coals sometimes are met minerals of group of hydro-oxides of ferrum up to 2%.

The enrichment is determined only for beds 7 and I0,as medium and difficult.

The technical analysis determined that by properties the coals of the Sarry-Assia deposit are gas,intermediate to long-flamed.The content of moisture analytical for non-oxidised samples- 3.64-4.85%.Yield of volatiles - 33.33-4I.4I%.The coking button - is powder -like and agglutinated.

Thus, at the base of the results of coal-petrographic and technical investigations of coals of Sarry-Assia deposit ,the latters can be referred to gas poorly caking and should be considered as energetic raw material.

Taking into account that the deposit have been studied at small square and that it connection with the Kotal-Sabzak and Askhorak deposits is clearly seen,here at the adjacent squares one can wait for considerable increase of coal reserves. Besides, to the West,between the Sarry-Assia and Shabashek deposit there are outcropps of coal--bearing strata,showing at the total unic coal-bearing stripe,within the limits of which there are some outcropps of the Jurassic deposits,may be ,coal-bearing at the depth.

Sabzak-Kotal deposit (I2).

The deposit is situated in 5.5 km to the South-South-East from the Sarry-Assia deposit,in the uppers of right fork of the Sarry-Assia river (Darrai-Alma). Here, in the wing of anticlinal folding are recovered coal-bearing deposits of the Shabashek suite of Middle Jurassic and non-coal deposits of the Upper Jurassic (fig.II7). Here is well seen between the sediments of the Middle and Upper Jurassic the angle inconformity.

The Upper Jurassic deposits with angle unconformity and stratigraphical are overlapped by the deposits of the Cretaceous and Paleocene ages.

At the deposit is recovered only the upper part of the coal-bearing strata,with thickness not more than I00-I20 m.This part of the section answers the upper horizons of coal-bearing strata of the Sarry-Assia deposit.

In the visible part of the section there are threee coal beds (fig. I20). The upper bed (exp.450) was recovered by trench and sampled.It is a complicated bed,consisting of 6 coal bands with thickness from 0.I2 up to 0.85 m,divided by rock interbeds wit with thickness from 0.06 up to 0.I4 m .

Lower by section there are some more 4 coal beds,which have thickness from I40- up to 280 m (exp. 3220-3223).

In petrographic structure of beds take part half-shining and dull coals. Sometimes,are met heavily crumpled,undetermined coal types.Among the half-shining coals are mentioned the species: lenses-like-striped,striped,fine-striped with numerous lenses of fusenite,sometimes with striated base.

The dull coals are of two species: ash and fusene.Fusene dull ,as a rule, are represented by large lenses and stripes of fusene composition up to I.5 cm with stripes and lenses of Vitrene with thickness 0.3-0.5 cm.

Microcomponent composition of coals of the Sabzak-Kotal deposit is characterised

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by lower content pf components of Vitrinite groups 50.I-77.4%.The content of other components is the following: Vitrinite group -I2.2 -20.9 and Fusenite group -7.9-30.8%.The sum of the emanciated components amounts in average 36% (from I7-up to 42%).By microcomponent composition these coals are close to beds of the upper half of the section of the Sarry-Assia deposit.

The coal methamorphism degree is determined as intermediate from long-flamed to gas.

The base of mineral admixtures in the coals is made up by clayey substance (from I.8 up to 28%).The clayey substance is closely connected with gelified coal mass, being located by fine interbeds and lenses and that is why it is very difficult to be separated.Very often can be met hydro oxides (up to I.9%). Sometimes are met small quantities of Carbonaceous.Quartz is seen very rare.

The coal enrichment is middle,and by separate bands- easy. The specific coal weight changes from I.38 up to I.4I.

Technical analysis showdd that the coals belong to low-ash and medium-ash. The high content of moisture (8.96-I3.8%) testifies the degree of coal oxidation. The index of volatiles yield because of heavy oxidation does not give the real idea of coal type.Taking into account the petrographical composition and methamorphism degree of coals one can suppose that in non- oxidised state the volatile yield will amount 34-35%.

Below are given the results of technical analysis.(see Russian report,page 542)

Coals of the deposit can be used as good energetic fuel.

Besides the mentioned beds there are the uotsropps of coal-bearing Jurassic with the signs of coal beds.Besides,above by the valley of sai,that is to the West takes place the sinking of coal-bearing strata: by the both sides of the valley are recovered the Upper Jurassic deposits,under which at the considerable depth can be recovered the coal-bearing strata.

Thus, the Sabzak-Kotal and Sarry-Assia deposits represent one coal deposit, separated thank to the manifestations of fractured tectonics.

Askhorak coal manifestation (I3).

Coal beds are recovered in the left slope of the Askhorak river,in I0 km above the Doabi-Shakhpasand or in I2 km to the South-East from the Sabzak-Kotal deposit.By the valley passes the horse pass,by which the area of coal manifestation is connected with the above mentioned points. Here,in its laeft tributary Sadzak-Bandi are recovered the coal -bearing deposits,which answer,apparently, the uppers of coal-bearing strata of the Sarry-Assia deposit,that is to say the deposits of the Shabashek suite of the Middle Jurassic (fig.I2I).

The coal-bearing strata is recovered partialy (its upper horizons)in the southern wing of anticlinal folding,having sub-latitudinal strike.The beds are dipping to N and NNW with angles from 20-80°. Besides there is fine crumpleness of beds.The coal-bearing deposits mainly atr represented by the interchanging of aleurolites, sandstones,gravelites,conglomerates and dense clays.

Thickness of the visible part of the section is 265 m.Besides,the very upperest p part of the section answers the upper-Jurassic above-coal-bearing deposits.In the low part of the section by trenches were recovered 4 coal beds of complicated structure.

Upper bed -is of complicated structure,consists of I2 coal band with thickness from 0.05 up to 0.5 m ,divided by interbeds of dense clays with thickness from 0.I0 up to 0.20 m. The total thickness of the bed is 3.9 m.The sum thickness of coal bands 3.35

Second bed (exp.32I0) lays in 2.85 m below the upper and consists from two coal bands 0.7 and 0.25 m,divided by the interbed of dense clays with thickness 0.I0 m.The total thickness of the bed is I.05 m.Thickness of coal bands is 0.95 m.

Third bed (exp.32II) represents two interbeds of coal: the upper-thickness 0.40 m and the low-thickness 0.55 m are divided by the interbed of clays with thickness I.30 m

Fourth bed (exp.32I3) is also of complicated structure with interbeds of coaly clays with thickness up to 0.I0 m.The total thickness of the bed is I.0 m.The sum thickness of coal mass is 0.70 m.

Besides the described above beds in the section there is a number of fine coal interbeds with thickness less than 0.50 m and turf areas with coal soot.

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Coal beds are strongly crumpled.There can be mentioned numerous mirrows of slipping.The coal is mainly half-shining,striped,sometimes is met half-dull,striated.

The substance composition of coals is characterised by very high percent of components of vitrinite group.

Leiptinite is represented mainly by rosin bodies in vitrene;rare by cutickes and rosin.The components of semyvitrinite group and fusenite have the appearance of the fragments.

Methamorphism of coals is determined by the colour of gelified mass and micro--spores,as intermediate from long-flamed to gas (I_3 - II_1).

The petrographical study established that the mineral admixtures are represented mainly by clay minerals,which quantity changes from 5.0 up to I9.8%.Quartz is met rare in the quantity of not more than I.5%.

Technical analysises were carried out by samples of the oxidised coal.The moisture of coal is within the limits of II.6-I4.46%.Ashness of coals -from I7.5 up to 35.4 that is the coals belong to high ash.Volatile yield -from 40.0 up to 43.9%.The coking remnant is powder-like.

According to the volatile yield the coals can be referred to mark "D"-long-flamed.

Below are given the results of technical analysises.(see Russian report,page545)

It should be noted that in connection with inconsiderable volume of the carried out mining works it is very difficult to say something certain about the perspectives of the Askhorak coal manifestation.To estimate it more completely it is necessary to carry out the more detailed works.

In I.2 km to NNE from the Askhorak coal manifestation is situated another inconsiderable coal manifestation(I4).Here is exposed the band of the interchanging black "striped" coaly dense clays and aleurolites.In coaly dense clays are observed lenses of shining coal with thickness up to 0.05 m.Here can be observed some close interbeds of coal with thickness from 0.06 up to 0.I0 m.From the side the deposits of the Jurassic are very like to the ones in the Askhorak valley and compose the unic strata.

This all gives the basement to single out here the square for carrying out search-prospecting works.However, there is no use to wait considerable coal reserves.

DEPOSITS AND COAL MANIFESTATIONS OF THE SAIGAN-ISHPUSHTA COAL AREA.

Northern Ishpushta deposit (22).

The deposit is situated in the middle current of the Surkhab river,not far from old motor-road Kabul-Pil-i-Khumri(through the Shibar pass),in the valley of the river under the same name,in 2.5 km from its mouth.

Before at the deposit were carried out the searching and geological-prospecting works by different foreign companies,the materials of which,except of B.West(I942) were remained unknown.At the present time here are carrying out the exploitation works for coal production.With the document of of these works we also had no opportunity to get aquainted.

The deposit is confined to monoclinal,composed by the upper Triassic,Jurassic and Cretaceous-Paleogene deposits (fig.I22).The Jurassic deposits are dipping to the North--North-West with angles of 35-55°.From the South-East they are limited by the outcropps of rocks of Upper Triassic and in the North-West are overlapped by the deposits of the Cretaceous-Paleogene.They unconformably and with interval lay upon the Triassic rocks . At the basement of the Jurassic very rare is present bazal horizon of conglomerates.; usualy this section begins by the dense,sometimes coaly clays,mergels with lenses (up to 0.08 m) of coal,aleurolites,sandstones,conglomerates.Above-there is the interchanging of conglomerates,sandstones,aleurolites and clays of light-brownish colouring. Thickness of the low Jurassic is maximum 294.0 m.Above with the outwashing and bazal conglomerates lay the Middle-Jurassic deposits which having thickness in 670 m are divided into a number of bands. To the low band ,which has thickness of 266.0 m and which is represented by the interchanging of conglomerates,sandstones,aleurolites and less dense clays,are confined the coal beds.There is no cycle in section of the Jurassic deposits.

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Coal beds in quantity of 5,with thickness from 0.10 up to 2.05 m lay in the interval of 334-402 m from the basement of the section (fig.123).In other parts of the section coal beds are not observed.

There are two beds of working thickness (more than 1.00 m) at the deposit: the low and the upper or " main",both are of complicated and changing structure and unpersistent thickness.

At the deposit at the present time is exploited the "upper " or "main" bed as the most persistent and less complicated by structure.

According to the exploitation conditions the deposit is divided into 5 areas, which are situated by strike of the strata from the South-West to the North - East.

The low bed (exp.5030) is of complicated structure,consists of 4 coal bands with thickness of 0.2-0.34 m,divided by rock interbeds (fig.123).The total thickness of the bed - is 1.49 m.The sum thickness of coal bands is 1.04 m.Before this bed had been exploited,but at the present time its production is not carrying out,as this bed is not persistent by strike.

"the Upper" or "the Main" bed lays in 33.3 m above.The bed is of complicated structure,besides the quantity of rock interbeds increases to the North-East and to the South-West from the Central area deposit.

At the area No. 2(central),which is situated at the left slope of the valley, the bed has relatively simple structure with thickness of 3.76 m(area 2,adit 101). Further in 500 m to the East(area 4,drift 124) the bed has already complicated structure and consists of triangular bands (o.30;0.70;0.80),divided by rock interbeds ((0.15;0.12 m).The total thickness of the bed here is 2.32 m with sum thickness of coal bands in 2.05 m.

To the East ,in 200 m from the preceeding crossing (area 5,drift 91),the quantity of rock interbeds in the bed increases and thickness diminishes.Here the bed consists not from 8 coal bands,divided by rock interbeds.The total thickness of the bed is 2.75 However for the working thickness we can accept only the low part 1.95 m ,as the upper coal band in 0.20 m is separated from the low part of the bed by the interbeds of dense clay in 0.60 m.

Thus,the working thickness of the bed amounts 1.95 m with sum thickness of coal bands in 1.50 m.

To the North-East, with increasing the complication of bed structure increases the ash capacity of coal bands from 2.5%(area 2) up to 41.33 (area 5).The soil and roof of the bed by strike are change and they are represented either by coaly dense clays or aleurolites and sandstones.

Above the "Upper" or the "main" bed in 16.5 m above by section there is one more coal bed of non-working thickness,which consists from two coal bands 0.22 and 0.28 m, divided by rock interbed 0.13 m.

Besides the described beds ,in the section of coal-bearing strata there is a number of coal interbeds with thickness from 0.05 up to 0.15 m.

Coal of all beds of the deposit is heavily crumpled,with numerous slipping mirrows ,flaky,in the process of exploitation disperses into powder.The observing in the beds sharp pinchings and swellings are conditioned;mainly,by tectonical reasons.

Microcomponent composition of coals is characterised by small percent of component of Vitrinite group 33.8-43.0%,by high percent of components of semyvitrinite group 47.6-64.4% and by small quantity of components of fusenite group 0.7-8.8%.The sum of the emanciated components amounts from 39 up to 44%.

Mineral admixtures in coals are characterised by constant presence of clayey minerals,Carbonate and Quartz.Apparently, the most part of clay and quartz,mainly, were carried by the jointings during the tectonic grinding of the coal.The Carbonate is present in all chosen samples from o.9 up to 2.0%.Carbonate,apparently, is represented by Calcite and Ciderite.

The repeted investigations had not approved this high percent of semyvitrinite group,but showed that the quantity of fusenite microcomponents had been sharply lowered The reason for this is that in te group of semyvitrinite were included the specific formations,which cemented grains and flakes of coal.Under microscope they were seen as unstructural semyfusenite of greyish-white tiny with low relief.Besides , all these

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formations showed the geavy anizotrope capacity in the polarised reflected light.

The coal enrichment changes from medium up to very difficult.

Methamorphism of the coal deposit is detrmined as II_{1-2}, that is gas low and medium--methamorphised. The samples of the Ishpushta coals had been investigated before at the laboratory of coal petrology IG and RGI, where the extent of reflected capacity was determined within the limits IO K = 79%.

The result of technical sample analysises, taken out of the underground minings. (see Russian report, page 550).

As we can see , the coal moisture is comparatively is not high and it is within the limits from 2.I5% up to 2.84%.

The ash capacity of the "upper" or "main" bed at area 2 is not considerable -about 2,5%. At areas 5 and 4, in the eastern part of t e deposit coals are high-ash. The percent of ash amountsby separate samples of the working beds from 20.8% up to 37.6%.

The volatile yield changes within the limits of 28-34%, which is considerably lower t the level, which corresponds to gas coals. This is explained by high percent of microcomponents of fusenite and semyvitrinite groups. Coal with such composition will not show the caking capacity. The coking remnant after the ignition is powder -like or only agglutinated.

At the deposit was mentioned coal selfiignition capacity. Such manifestations were observed in the old openings, driven by the low bed at area 3 and by "upper" or "main" at area 4.

To the North-East from the Ishpushta deposit near Barfak pass, at strike of coal--bearing strata was recovered the coal interbed with thickness of 0.23 m.

Thus, the coal-bearing strata of the Ishpushta deposit with beds of working thickness is traced by strike in total at 2.0 km. The sinking of coal-bearing strata takes place in the North-North-West direction, where it is overlapped by the above-lying Jurassic deposits.

Perspectives of the deposit exploitation by the dipping are confined, that is in 5km at the North-West takes place large overthrust, by which the Jurassic and Cretaceous deposits contact with the deposits of the Paleozoic, the coal-bearing strata here is sunk at t the depth up to 2 000 m.

In connection with inconsiderable square of the distribution of the working coal-bearing capacity, the reserves of the Ishpushta deposit are confined (not more than 2.5 mln. tons) and it is of no interest fot the development of the coal-production enterprise.

South Ishpushta deposit (23).

The deposit is situated in the uppers of right tributary of the Igpugta river, in 2 km to the South-East from the North Ishpushta deposit (fig.I22).

The deposit is situated at the same stratigraphical level that the North Ishpushta deposit and is confined to the same coal band that the North Ishpushta deposit. The occurrence of the rocks here is somewhat more gentle: to the North-West with angle 25-35°.

"upper" or "main" bed, which here is exploited is alternated completely by coaly dense clays, containing interbeds of pure coal with thickness 0.20-0.50 m. As clays, as coal , they are heavily grinded tectonically. Coal represent the natural bricket("king coal"); when is heavily struck, it disperses into powder.

in spite of the considerable thickness the bed here is exploited because of available use of the coal for heating(naturally, in brickets).

The reserves of coal are insignificant. The commercial interest does not represent.

Barfak coal manifestation (24).

The deposit is situated in 2.5 km to the East-North-East from North Ishpushta deposi in Kau-Shandos sai.

The coal manifestation is confined to the lowers of "low part" of Middle Jurassic and occupies the same stratigraphical level, that the coal beds of the Ishpushta deposit and practically is the continuation to the East (fig.I22). Here in I km from the mouth of Kau-Shandos sai at the extension of 600 m in the clay band by old mining openings were recovered 3 close coal interbeds with thickness 0.I5; 0.20; 0.35 m and bed of coaly clays with short nest-like lenses of coal with thickness from 0.0I up to 0.I5 m.

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Coals in interbeds are crumpled,with numerous slipping mirrows.

The coal manifestation is of no practical interest and speaks only about the pinching out of the coals of the Ishpushta deposit in the direction to the East.

DEPOSITS AND COAL MANIFESTATIONS OF THE PUL-I-KHUMRI COAL AREA.

Karkar deposit (27).

Thedeposit is situated in I2 km to the North from city Pul-i-Khumri and connected with it by motor-road.At the present time at the deposit are carrying out the exp. exploitated works.Thedeposit area is composed by the deposits of the Upper Jurassic age(Callovian stage),represented in the low part by continental roughly-Terrigene deposits; in the upper -by sea small-Terrigene deposits with the subordinated limestones (fig.I24).In 243 m from the basement of the Callovian deposits lays the horizon with thickness about 20 m of sandstones,aleurolites and argillites,often coloured in red-brownish tones,among which is concluded the coal bed of the working thickness.

Above the coal bed (in its roof) lays 20 cm bed of aleurolite sandstone,which is overlapped by mergels with sea fauna of the Callovian stage.

The Callovian deposits monoclinally are dipping to the South-West with angle of 30-35° and are complicated by the fine undulated folding and fractures.

The coal bed which is exploitated at the deposit has complicated structure.Its thickness ranges from 0.6 up to 6.0 m,amounting in average 3-4 m.

The bed is recovered by the underground mining openings by the dipping at 400-450 m and by strike at 800-900 m.

Coal in the bed is heavily crumpled,faulted with amplitudes of shifting up to 3-4m. Coal of the working bed is represented by crumpled,flaky variaties of uncertain type.

Petrographical characteristics of coal , taken out of the underground opening is given in the table.(see Russian report,page 555).

In I960 the laboratory of petrology of coal carried out the investigation of two samples.Lower in the table is given their substance composition.
(see Russian report ,page 555).

Proceeding from the table the coal bed is characterised by high percent of vitrinite 74-80%,by considerable percent ofsemyvitrinite 9-I7% and by small quantity of fusenite 5-I2%.

Extent of coal metamorphism coal is determined according the index of reflected capacity(I0 K %),which turned to be of 7I%.This maltitude corresponds to long-flamed medium-metamorphised coals.

Coal with such petrographic characteristics hardly display even the signs of caking Mineral admixtures in the coal are characterised by considerable quantity of clayey minerals and by small presence of Quartz,Ferrum Hydro-oxides and Pyrite.

The results of technical analysis for coal sample are given at table(see Russian report,page 555).

Coals of the Karkar deposit can be used as energetic fuel.

Dudkash deposit (28).

Thedeposit is situated in 3 km to the South-South-West from the Karakar deposit and practically,it is the continuation of its area,situated at the same strike of the same coal-bearing strata(fig.I24).Geological structure of the deposit area is the same as at the Karkar deposit;is exploited the same coal bed,having thickness of 0.9 m. It is with pinch up to 3 m and rare up to 5 m traced by the underground mining openings by dipping at I60 m and by strike at 400 m.

Among the coals of the Dudkash deposit dominate dull variaties,rarely are met half-shining and rare half-dull.Among the half-shining coals are met indistinctly--striated,flaky variaties with metal lustre.Rarely are met foliated,striated half--shining coals,mineralised by jointings with ferrum hydro-oxides.Half-dull coals are striated with fine lenses of vitrene.Dull coals are usualy ash,flaky,with great quantity of fusene.

The substance composition of coals is characterised by considerable percent of microcomponents of vitrinite group (by separate samples up to 82.5%).The content of semyvitrinite and fusenite is not high 7-8%.

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Characteristics of coal by data of coal petrographic investigations is given in table(see Russian report,page 557).

Extent of coal metamorphism is I_3 - long-flamed high-metamorphised.

Mineral admixtures are characterised by a lot of clayey minerals and persistent quartz presence.The majority of these minerals appeared to be in coal,apparently, during the grinding and trituration.Ferrum and Calcite hydro-oxides are in small quantities.In fresh samples is met Pyrite (up to 2.3%).

The coal enrichment will be difficult or very difficult.

The coals of the Dudkash deposit can be used as energetic fuel.

West Dudkash coal manifestation (30)

The deposit is situated in I.4 km to WSW from the Dudkash deposit,near the motor--road,which connects the Dudkash deposit with city Pul-i-Khumri.

The area of coal manifestation is composed by the intebedded aleurolites,densed o often by clayey clays with bands of sandstones of the Low Jurassic age(fig.I24).The rocks of low Jurassic,having total thickness of 808.0 m unconformably lay at the fragmentary-tuff-gene rocks of the Ret stage and in its turn unconformably are over--lapped by the rocks of analogic composition of the Middle Jurassic age.

The rocks of low Jurassic lay,in general,monoclinally,with dipping to the West with angles 22-25°.

In the upp r part of the Low Jurassic section there are some bands of aleurolites and dense coaly clays with beds of coal.Here by trenches at the left slope of the valley is recovered a number of separated coal beds and interbeds with thickness from 0.05 up to 2.05 m,in total up to 23,besides the majority of them has thickness from 0.05 up to 0.50 m and only two beds in the very upper of the section have thickness 2.05 m and 0.60 m.The coal enrichment in some bands has thickness up to I4 m and reaches up to I8%.

The low bed is of complicated structure,has the thickness of 2.05 m.The low coal bed with thickness of 0.85 m is separated from the upper one,which has the same thickness, by the interbed of coaly clay with thickness of 0.35-0.40 m.Besides,the upp upper coal band contains rare fine interbeds of coaly clay (2-3 cm).

The upper bed is also of complicated structure,has thickness od 0.60 m.Coal is he heavily weathered,ferruginated,sometimes sooty.In the middle part the coal bed contain interbeds of clay with thickness of 0.05 m.Both coal beds are traced at 20-25 m,but by vysypka more than at 0.9 km to the South from the Dudkash valley.At the same stratigra phical level,in 3.0 km to the South is situated the Sanga West (32) coal manifestation which confirms the extention of the low-Jurassic coal-bearing band of more than 3.0 km

Coal manifestations of the West Dudkash coal manifestation are represented by half-dull and half-shining variaties.

The substance-petrographical composition of ordinary coal is characterised by high percent of fusenite20-24%.Vitrinite percent is 70-7I%.Vitrinite grains are broken by jointings,covered with caverns,which speaks of strong coal oxidation.The charac-teristics of petrographic peculiarities of coal is given in the table (see Russian report,page 559).

By extent of metamorphism coal belongs to intermediate from long-flamed to gas.

Mineral admixtures,as it can be seen from the table,are represented by clayey material and grains of Quartz.Pyrite is not found because of strongoxidation of coal.

Technical analysises of samples of the oxidised coal are given in the table (see Russian report,page 560).

There is exceeding content of moisture -II.82-I2.24%.Ashness of the coal is also exceeded 30.32-34.I6%.

Apparently,the coals of the described manifestation can be considered as high ash energetic fuel.

In the area of the West Dudkash and Sangach coal manifestations is singled out square of about 20 km^2.(IX).It represents practical interest for setting of the detailed searching-prospecting works for the energetic coal,as it is situated near the Karkar mine in action.

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East Sangach coal manifestation (3I).

The deposit is situated in the uppers of the Sangach sai in 8 km to the ENE from city Pul-i-Khumri,and in 30 km to the North from the Dudkash deposit.

Coal-bearing deposits of the East Sangach coal manifestation are the continuation of the coal-bearing strata ofthe Dudkash deposit (fig. I24).The geological section is represented here by the interchanging of dense clays,aleurolites and sandstones of continental origin,among which lay the coal bed;it is overlapped by aleurolites and limestones with sea fauna of the Callovian stage. The rocks monoclinally are dipping to east with angle of 20°.

In inclination at the right slope the coal bed has thickness of 0.90 m.Coal is crumpled,ruled,while striking it disperses into powder. In some places,in contact with coal bed there can be seen fine goffers,inclined to west (fig.I25).

The base of coals is also represented by half-dull striated and fine-striped coals, with the percentage of 65%.Half-shining striated-striped and striped coals constitute 20-30%.Dull coals are met with 5%.Sometimes are met clarain,indistinctly-striated coals. Coal preserves a lot of Pyrite,which gives sulphur of coal about 2.5%.

Microcomponent composition of the coal is notable for the lower percent of component of Vitrinite group and for higher percent of Fusenite.The sum of the emanciated componenents amounts 25%.

Petrographical characteristics is the following:(see Russian report,page 56I)

Metamorphism of coals is lowered,enrichment is difficult.

Chemical analysis of one sample from the oxidised coal is given in the following table:(see Russian report,page 56I).

The Karkar,Dudkash and Sangach coal deposits represent the unic square of the distribution of one coal-bearing strata.However,the perspectives of this square are limited,as in the south-west direction from the Karkar deposit to the Sangach sai the thickness of coal-bearing strata and the total coal-bearing capacity sharply diminishes. The coal bed,exposed at the Karkar, in this direction diminishes in thickness and branches at some bands.

By dipping the coal-bearing strata is sunk at the considerable depth.

West Sangach coal manifestation (32).

It is situated in 0.6 km to the West from the East Sangach coal manifestation,at the left slope of the Sangach valley.

In geological respect the coal manifestation is confined to the upper part of the Low-Jurassic section,which is represented by the interchanging of bands of sandstones, aleurolites and dense,often ~~clayey~~ coaly clays with coal beds.These deposits occupy the same stratigraphic level as the ones described in the West Dudkash coal manifestation (fig.I24);the rocks are dipping monoclinally to the East-South-East under angle of 20°. Can be seen poor lamination.

Here at the right slope of the valley in I.5 m above its bottom there is an inclination by coal bed,having complicated structure.The upper band of coal with thickness of o.90 m is represented by half-dull variaties with interbeds of shining (up to 2-3 mm). At its foot and roof are preserved interbeds (3-I0 mm) of coaly clay.Below there is a dense cloddy clay with lenses of lustre coal of thickness I.30 m and then follow three bands of coal with thickness 0.I0-0.I5 m,which are divided by coaly clays of the same thickness. The coal is crumpled a little.

The inclination is waterd.Coals,mainly,are represented by half-dull striated and fine-striped variaties (50-60%),less by half-lustre striated-striped (20-30%) and more less by dull (5%).Clarain and indistinct striated coals are rare.Coal is characterised by considerable percent of clayey minerals and quartz.

Microcomponent composition of coals is notable for lower percent of components of Vitrinite group and by higher of Fusenite.Sum of the emanciated components -4I%.

The results of the petrographical studies are given in the table(see Russian report page 563).

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Metamorphism of coals is lowered;enrichment is difficult.

West Sangach coal manifestation has no practical interest.However,taking into account the presence of coals at the same stratigraphical level in the Dudkash sai West Dudkash coal manifestation) there are some reasons to suppose that along the whole interval,consisting of more than 3 km will be traced coal-bearing deposit with one or two coal beds with thickness in limits of about I.0 m (0.80 -0.90 m).
That is why the area between the Dudkash and Sangach valleys is recommended for more detailed search-prospecting works.

Nakhrin deposit (33).

Nakhrin deposit is situated in 2 km from city Nakhrin,in the valley of left tributary of the river of the same name.Up to the deposit there is soil motor road,which connects it with cities Baglan,Kunduz,etc.At the deposit takes place domestic coal extraction from the open minings for local needs.

The deposit area is composed by Upper-triassic and Jurassic deposits,represented by the three divisions(fig.I26).The coal-bearing capacity is confined to mddle-low divisions of the Jurassic,dissected at some bands,more exactly,to the upper part of the band "c",having thickness of 84.0 m and band "e" -of 270.0 m.

In the uppers of band "e" are mentioned 3 coal beds with thickness of 0.35;0.35 and 0.45 m-they are of no practical meaning.The coal bearing strata with working beds referred to band "e",lays in 752 m from the basement of the Jurassic section and envelopes interval in 40 m.It is represented by the interchanging of mainly dense clays, coaly dense clays,aleurolites and rare bands of sandstones.Here had been recovered and sampled 4 coal beds with thickness from 0.90 up to 4.40 m (fig.I23).It is possible that there are more coal beds at the deposit (up to 8).In connection with the complication of tectonical structure,especially in the South-West part of the deposit,their correlation without special prospecting works is difficult.All the beds have complicated structure.The distance between them ranges from 5 up to I5 m.The distribution area of coal -bearing deposits is very limited and does not exceed 3 km^2.From the north-east and south-west the deposit is limited by overthrusts,and from the north--west - by the distribution of the effusives of the upper Triassic.

Coal-bearing strata,especially in the south-west part of the deposit , is complicated by fine folding and fracture faults.

Coal bedsare strongly crumpled and very often are represented by crushed foliated coal.Beds are not persistent by strike,often are substituted by coaly clays.

The coal bed represents tectonical pinch into core of anticlinal folding,limited with the fault;its thickness in the explorated part -7.20 m by strike (sai Chinorak) diminishes up to 4.40 m.In the upper part of the bed-interbed of thickness in 0.30 m of dense clay.Coal is ash,strongly crushed up to foliated sypuchka.

At this area there are more three coal beds: one-with thickness of I.0 m lies above the explorated bed and two -are of thickness of 0.75 and 0.90 m - below it.

Coals of the Nakhrin deposit are characterised by strong crumpleness and very high percent of ashness. Among them are singled out the following petrographical variaties:half-lustre,striated and indistinct-striated coals,half-dull coals are represented by ash fine-striated variaties,crumpled by fusene and rare half-dull with homogenous base,metal-like lustre and rare vitrene scares.The majority of coals is ash,crumpled,flaky,uncertain type.

The substance composition of coals is characterised by lower percent of component of vitrinite group -50.3-79.3%,amount quantity of semyvitrene,sometimes fusene.The sum of emanciated components is high enough-I9-35%,in average -28%. Mineral admixtures are characterised by big quantity of clayey minerals from 8.4 up to 3I.I%.

In the bed with swell of thickness up to 7.20 m the coal is of low ashness and that is why it has very few mineral admixtures.

In all taken samples there is quartz in quantities from 0.4 -4.2%.Sometimes can be met Calcite and hydro-oxides of Ferrum.

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Petrographical characteristics of coals of the Nakhrin deposit is given in the table:(see Russian report,page 566).

Metamorphism of coals is determined as II2 - gas low-metamorphised.Enrichment of coals is difficult and very difficult.

Coal of the deposit,mainly,is of high ashness,except the bed with swell of thickness up to 7.20 m.The moisture of coal in samples,taken from the zone of weathering, changes within the limits of 4.5-II.3%.

The volatile yield depends on substance composition of organic mass and ashness ar ranges in limits of 30-44%.

Results of technical analysis of the Nakhrin coals.(see Russian report,page 567)

Taking into account inconsiderable reserves of the Nakhrin deposit,theirperspectiveness and low qualities,it is not possible to consider them as base for construction of the mining-production enterprise.These coals can be used for local needs.

D E P O S I T S A N D C O A L M A N I F E S T A T I O N S O F T H E C H A L-

- N A M A K A B C O A L A R E A.

Chal deposit (33,34)

The deposit is situated in 4.5 km to the south-west from village Chal,at the left slope of the Chal river (or Tanga),in the mouth of small dry sai.From village Ishkamysh up to Chal pass one can drive a car,further from the pass up to the deposit,down along the Pass sai I.5 km passes a horse pass.Old openings and outcropps with coal beds are at the right slope of the sai in 0.5 km from the Tanga river.

The deposit area is complicated by the deposits of the Middle Jurassic,its "upper part",which is represented by the interchanging of dense clays,aleurolites and sandstones (fig. I27).At the deposit area beds lay very steeply.The section is doubled and represents the core of izoclinal folding,overturned to the south-west under angle of80° In the upper part of the slope this folding comes into the laying folding also overturned tothe south-west.

Here are singled out two areas Chal -I (low) and Chal II (upper),situated in 0.5 from each other,in the right slope of the Pass sai.

Chal-I (main) area is represented by two coal beds-west and east (fig.I29),which a are seen in steeply layed part of the section,in the low part of the slope(exp.I0706).

West bed-II has thickness of 0.6I m.It is divided at two coal bands:upper -thickne 0.20 m and lower -thickness 0.4I m,inte bed of coaly clay with thickness of 0.09 m. Below and above the bed can be mentioned interbeds of lustre coal with thicknes from 0.03 up to 0.06 m.

East bed is situated in I0-I2 m below by section and has simple structure and thic ness of 0.25 m.Besides,at the left slope of the dry sai,against the Chal deposit(across the valley) by thetrench had been recovered coal bed with thickness in 0.22 m,which is the continuation of the west bed of the Chal-I deposit (exp.II079).The distance from th old openings at the first slope of the sai up to outcrop at the left one amounts about 200 m.

It was established that the Chal-I deposit had been exploited since I928 up to I958 From the coal made "coke" and used at the Baglan sugar plant for cleaning sugar.Along the bed were driving horizontal openings with depth up to I00 m .The latter,the lowest opening was driven below sai level at I0-I2 m out of the inclination.However soon it became watered.Thickness of the coal bed in the openings ranges from 0.50 m up to complete pinching out,often amounting 0.40 m.In faces of horizontal openings at the depth of I00 m,thickness of coal bed as a rule diminished up to 0.20-0.I0 m.

Chal -II area upper is composed of the overturned to the south-west deposits of Middle Jurassic,on which lay bazal sandstones (70-80 m) of the upper Jurassic(Kallovei band I),above which one can observe a band up to 80 m of dark-grey almost black dense clays,interbedded with sandstones (Kallovian,band II).In its basement are mentioned three beds of coal of simple structure (fig. I29).The first-near the very bazal sandstones with thickness of 0.30 m,the second-at 5 m above,of complicated structure,its thickness 0.57 m and the third -at I0 m above the first one,of little thickness and with big percent of clay.The first two beds were exploited from the surface and out of them was extracted "coke".

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Besides the described coal beds by B.N.Androsov,at the periods of low water was also described coal bed of complicated structure (exp.I3) with thickness of I.74 m (pure coal - 0.64 m).

Chal deposit beds at 60% are composed by different half-lustre petrographical species.About 20% go for vitrene-clarain lustre coal,I5% is represented by crumpled flaky and 5%-by fusene mineralised coal.

According to the content of vitrinite,as it is seen from the table, the limits of ranges amount 53-58%.Semyvitrinite for some samples changes from 8-23%.The same refers to the group of fusenite.

Mineral components are represented mainly by clayey substance and quartz grains. Mineral admixtures dispersively are distributed in coal.

Almost all samples show considerable oxidation of coal,which we can see by the jointing character at vitrinite grains.

By metamorphism coal from different points of coal manifestation is not identical. Sometimes are met metamorphised coals (up to stage .But in the majority of cases the metamorphism is estimated in the limits of Cl-Ch .The mentioned petrographical parametters allow to suppose that coals by propertiesa are more close to mark "C".This is also confirmed by the character of anizotropy of vitrinite of the heated coal.

Chemical-technical analysises,which are given below,allow to say that the majority of coal samples is taken from the zone of oxidation.Thus, the content of moisture by separate samples changes from 2.05% up to 7.79%.The less oxidised coals have moisture 2.05-2.80%.Besides,they are characterised by the volatile yield 20.5%-25.2%.Apparently, in non-oxidised coal this index will be about 20-22%.

Coal ashness is high enough,reaches usualy 20-37.8%.

In the elementary composition of organic mass is observed higher content of Carbon - 89.62%.

Thus, the coal petrographical and chemical analysises of Chal coals show that some of them belong to mark "C",others - to intermediate between coking and emanciated.

Chemical-technical characteristics of Chal -I and Chal -II coal manifestations. (see Russian report,page 571)

Darrai-Kolon deposit (37,37a).

The deposit is situated in sai of the same name,in 2.6 km above by the Chal river ((Tanga)from the place,in 4 km to south-south-west from Chal village.

Coal beds are exposed in interval 300-400 m upwards by the flow from the mouth of Darrai-Kolon sai (37a) as well as in Darrai-Kolon sai ,in its first from the below right tributary (37).

The deposit area has complicated geological structure (fig.I27).Here the deposits of low (360 m) and middle (more than 600 m) Jurassic are overturned to the north-west and have dipping in the direction of south-east under angle 60-70°.From the south and west they by gentle overthrust are overlapped by the deposits of Middle-Upper Jurassic, having also overturned to the north-west occurrence and dipping to the south-east direction with angles from I5-50°.The overthrust line cuts coal beds in Darrai-Kolon sai and contours in plan some fistones.

Low-Jurassic deposits lay transgressively(?) at the effusive formations of the Rat stage of the Upper Triassic.They are represented by the interchanging of beds of dense and coaly clays,aleurolites,sandstones,less tuff-sandstones and tuffs.The presence of tuffogene rocks is the distinctive feature of the low-Jurassic section in this area.

In middle-Jurassic deposits which have many common lytologic features the tuffogene rocks are absent.The second distinctive feature of this area in the whole is the existence of numerous small intrusions(dikes,stocks,etc.)sometimes with the square up to 0.I5 km^2.(I50 m x 600 m)mainly is of main composition (diabase porphyrites,spylite porphyrites,rare quartz porphyrites,etc.)These small intrusions break most of all in the form of leaf by leaf dikes or lengthed,conformably with strike of sedimentary rocks, stocks and rare in the form of cross-cutting bodies,upper-Triassic,low-Jurassic and less middle-Jurassic rocks.In the deposits of upper Jurrassic small intrusions were not observed.

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In conglomerates of the Callovian stage (bands II and III) are met numerous pebbles of analogical igneous rocks,which can show at their intrusion at the Pre-Upper-Jurassic period.

With cmall intrusions are connected noticable exocontact changes of the enclosed rocks,which were expressed in the process of the formation of hornblende zones,sometimes of big sizes (for example,to south-east from Chal village such zone has square of about I.5 km^2).

The pointed out small intrusions,apparently, had great influence and for the metamorphism of coal beds which lay in the Low-Middle-Jurassic deposits.

At the Darrai-Kolon area in the Low-Jurassic deposits were established coal beds, which lay approximately in I80 m above the basement of the Low-Jurassic section.The low two beds lay at the distance of I5-20 m ,one over the other. (fig. I29).

Low bed has simple structure and thickness of 0.70 m (exp.II065).In its roof and foot takes place the interbedding of clays (from 0.0I up to 0.07 m). and lustre coal (from 0.03 up to 0.06 m) with thickness of not more than 0.I0 m.

Upper bed has simple structure and thickness of 0.75 m (exp.II067).

Both beds have azimuth of dipping I25-I 60 ^{c},angle 75°.Here,a little higher by sai among the deposits of the undissected loe-middle Jurassic are established two more beds The low one lays near the overthrust line,its thickness 0.30 m (exp.II066).It is also as well asenclosed rocks has dipping to south with angle of 20°.The upper bed lays above by sai (exp.II06I) has complicated structure;its thickness I.4I m with sum thickness of coal in 0.3I m (coal interbeds from 0.04 up to 0.I0),dissected by interbed of coaly clay (from 0.03 up to 0.I5 m),dipping to south-east with angle 20-25°.Besides, here is well seen overthrust zone,represented by mylonitisated and ferruginisated rocks.

Besides the described beds, in the left bank of the Chal river (Tanga) is exposed a bed of complicated structure (III) with thickness of I.7I m (37 a,exp.4).Thickness of bands of pure coal is I.25 m (bands of coal with thickness from 0.I0 up to 0.30 m, are interbedded by coaly clays,clays and aleurolites with thickness of 0.04 up to 0.60 This bed may be lay at the basement of the Middle-Jurassic section.

In the structure of coal beds of the Darrai-Kolon coal manifestation dominate half-lustre indistinctly-striped and complex-striped coal variaties.Wide distribution have ash half-dull of homogenous massive tecture.As very rare interbeds with thickness up to 0.I m are met lustre clarain variaties.

Quantitive-petrographical analisis of coal of the thickest bands out of the outwashed beds showdhigher content of microcomponents of vitrinite group,reaching 62-78%. Vitrinite grains,as it can be seen under mycroscope,are cutted by the net of jointings.

Semyvitrinite and fusenite content is not high and amounts for each group 8-I0%.

Metamorphism degree of coal is determined as intermediate between coking high-metamorphised and emanciated low-metamorphised .

Mineral admixtures are distributed in coal and represented mainly, by minerals of group of clays and quartz grains.

Coal enrichment,apparently,will be difficult or very difficult.

Petrographical characteristics of the Darrai-Kolon coal manifestations:(see Russian report,page 576).

Chemical-technical characteristics of the Darrai-Kolon coal manifestation:(see Russian report,page 577).

The results of chemical-technical analyses are well coordinated with the date of coal-petrographical studies.As we can see from the table the ash content of unreached coal by separate bands ranges from 8.2 up to 45.5%,besides the more ash are the coal bands of thick beds.

All the coals have higher moisture content,which changes from 3.06 up to 7.60%. This level of moisture for the given stage of metamorphism is very high and points out at the coal oxidation.

The volatile yield on the less oxidising samples of coal amounts 20.I-24.I %,but in the non-oxidated state the coal of beds will be characterised by the volatile yield,which does not exceed I6-I7%.

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In the elementary composition of organic mass of coal the hydrogen content is low (3.00-3.64%),which shows at the possibility of sharp thermal action.

Thus, at the basement of coal petrographical and chemical-technical parameters one can say that the Darrai-Kolon coals belong to thermally emanciated,unvailable for the coking.In organic scales these coals can be used for energetc needs.

Siakh-Darra coal manifestation (35 and 36).

The coal manifestation is represented by two area:I and II.

Siakh-Darra -I -is situated in the mouth of the same name dry sai,parallel to the Pereval sai (with the Chal deposit) and interflowing into the Tanga river in 0.6 km abov the bridge.

Here are exposed the deposits of the Upper Jurassic in the overturned occurrence with dipping to south under angle of 50° (fig.I27).This is the same band of the interbedded dense clays,aleurolites and sandstones,which lays above the bazal bed of sandstones of the upper Jurassic and which encloses the Chal -II deposit(Callovei,band II).Here are also exposed several coal beds of little thickness from 0.I6 up to 0.26 m,divided by coaly dense clays with thickness from 0.09 up to I.50 m.The total thickness of the bed--4.I2 m; the total thickness of coal beds is I.I3 m (fig.I29).

At the right slope of the Chal river(Tanga) near the water course (38),at the strike of this coal bed are exposed three coal bands(exp.III23) with thickness: 0.30;0.05;0.25 m, divided by dense coaly clays with thickness of 0.80 m;0.70 m.Thus,the total extension of these coal bands,covered under the Chal valley (Tanga) can be not less than 0.5 km.

Siakh-Darra -II is situated in the same sai,in o.5 km above by the sai from the Siakh-Darra-I area.

It is confined to the deposits of the middle Jurassic,represented by the interchanging of bands of dense clays,sometimes of coaly aleurolites,sandstones,tuff-sandstones and rarely by conglomerates.The rocks are dipping to south and south-east under angle of 45°. Here in I00-80 m and even below the roof is observed a bed of carbonaceous coal of simple structure with thickness of 0.35 m.(exp.II092 and 993I),which is traced by strike at I00 m Above by the sai Siakh-Darra,in 60-70 m below by section,among the aleurolites were mentioned three more closedbeds with thickness of 0.I5;0.05 and 0.I3 m.These plates are seen in steep inclination and by strike are not traced.

The mentioned coal beds of the Siakh-Darra -II area are situated approximately at the same stratigraphical level,that the beds of the Chal-I deposit,but in the other tectonical block and cannot be parallelised or traced.

Carbonaceous coals of the Siakh-Darra coal manifestation have the higher ashness (I7-32%),have vitrinite of 45-56%.They are metamorphised up to stages coking little and medial metamorphised.

Because of inconsiderable scale of manifestation they are of no independent practical meaning.However,during the search-prospecting works in the [illegible] area the Chal deposits must be counted.

Zamburak coal manifestations (39,40).

Thedeposits are situated in the valley of the Zamburak river,near the village of the same name,in 4.5 km to the west from the Chal village.Up to Chal village one can go by auto.

The coal manifestations are situated at the area of the valley,where they change their direction very sharply from latitudinal to meridional.(fig.I27).

The area of coal manifestations is composed by the deposits of the low and middle Jurassic of the same character,that in the Darrai-Kolon area.The deposits are dipping to the north with angles of 30-70°.The low -Jurassic deposits contain a lot of beds of tuff--sandstones,tuffs and mainly tuff-lavas are broken by dikes and stocks of middle and basic rocks(diabases,quartz porphyrites).Middle-Jurassic deposits do not preserve tuffogene material.

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Zamburak I coal bed is exposed by trenches near the low part of the Zamburak settlement,in 80 m over the pass(fig.I30.exp.II095). It has dipping to the north wit. angle of 70°,with thickness of o.43 m,in the middle part-0.I4 m of interchanging of de dense clay and coal.Upwards by the slope (exp.I0I76),its thickness diminishes 0.45m. but in the lower part appeares a band of coaly clay with thickness of0.20 m and thus, it remains only 0.25 m of pure coal.

By strike of the bed to east ,in I50-200 m by the trench was discovered the same bed,its thickness I.02 m,interbed of clay in the middle part -0.08 m(exp.II096 and 9927).Above along the river,in 0.75 km from the Zamburak village,in the right valley side,under of the alluvial terrace deposits inconsiderably is exposed a complicated bed bed of the carbonaceous coal with thickness I.62 m(pure coal amounts I.53 m),the low coal band amounts I.00 m (bed IY,B.N.Androsov).This bed apparently lays in the low beds of the Middle-Jurassic section.

Zamburak -II(40) coal beds are situated above by the valley,approximately in I.0 k from the Zamburak-I.Here among the tuffogene-sedimentary rocks were established two bed beds of the carbonaceous coal.

Upper bed (Y,Y,B.N.Androsov) lays in the zone of tectonical overthrust among the tuffolavas in the form of the lenses about I0 m of length with maximum thickness I.7I m Coal is strongly crumpled.

Low bed (YY[I] B.N.Androsov) lays among the dense clays and tuffo-sandstones,in I80-200 m below by the section from the upper bed.Its thickness I.I6 m ,besides in its upper part there are two interbeds of clays with thickness 0.04 and 0.05 m.This bed is traced in the slope of the valley at the extension of 60 m ,twice being shifted by small fractures (amplitude I.5-2 m) of north-east strike.

At the strike of these beds to west (through waterdivision) approximately in 2 km is exposed coal bearing crumpled band,in which is observed coal bed of complicated stru structure with thickness up to I.2 m,which preserves 6 coal interbeds with thickness from 0.08 up to 0.I6 m (exp.III58).Here , but below by section,in tectonical wedges are seen the fragments of coal bed with thickness up to 0.50 m.

The mentioned shows at the extension of coal beds of the Zamburak-II to west at more than 2 km.

Coal beds of the Zamburak coal manifestations are characterised by the domination of half-lustre indistinctly-striped petrographical coal variaties.In most ca es coal is heavily crumpled and this makes difficulty to differentiate it at species.

Substance-petrographical coal composition is represented in table.From this table we can see that vitrinite content ranges from 60 up to 70%,that is coals are little differ by this index.The low content of diozenigirovated microcomponents of (2-7%), apparently,is connected with higher degree of metamorphism and difficulties of exact di diagnostics of microcomponents of groups of semyvitrinite and fusenite.Fusenitisised microcomponents (2-7%) Semyvitrinite content is not also high -8-I5%.

By petrographical signs the degree of metamorphism of coals of the Zamburak belong to the intermediate between C h and E l.

All the coals are characterised by distinct signs of thermal action.Vitrinite grains have whitish tint and often fine porosity.

Chemical-technological characteristics of coals of the Zamburak coal manifestations is given in the following table: (see Russian report,page 583).

Petrographical characteristics of coals of the Zamburak coal manifestation is the following:(see Russian report,page 583).

After the coal heating up to 600° C the character of coking substance is izotropic The numerated petrographical peculiarities allow to consider that by the features the Zamburak coals are emanciated and completely un-caking.This conclusion is confirmed by the chemical-technical analyses,given above.As we can see from the table un-oxidised or poorly oxidised coals with moisture up to 2% have volatile yield I4.7-I4.9%.

The Zamburak oxidised coals are characterised by the volatile yield 23.I-3I.0%. In such coals the percentage of moisture reaches 3.24-I0.32%.

Almost all coals of the Zamburak are notable for higher ashness,about 33.9-46.0%. In other samples the percentage of ash is a little lower 2I.7-23.9%.

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Thus,the Zamburak coal manifestations contain emanciated coals of low quality with very high ash percentage,that makes difficulty to use them even for local needs.

Bazarak coal manifestation (46).

The manifestation is situated in I.5 km to the west from Bandi-Mazar village,in 5.5 km to the south-east from Zamburak village.

Coal manifestation is situated directly on the pass in sai water course as well as in its slopes.

the coal manifestation area represents latitudinal-stretched sinclinalstructure, which is composed by the rocks of the Callovian stage,bands II and III (fig.I27). Synclinal in the core is complicated by small anticlinal folding stretched to south also,in the core of which are driven at the day surface lower horizons of the Callovia that is to say,bazal band -I. The rocks are dipping inpersistently to north-west, to south-west with angles from 40-90°. As in other places this band preserves in the middle part the band of the interbedding dense clays and aleurolites,containing three beds of Carbonaceous coal of complicated structure,divided by dense clays and aleurolit with thickness in 4.80 and 4.0 m,having the dipping (fig.I3I) to the south with angle 70°.

Low or Northern bed has thickness of 0.44 m, in its middle part the interbed of coaly clay with thickness of 0.05 m (trench I).

Middle bed is complicated ,has thickness 0.73 m.Coal bands with thickness of 0.06 to 0.I8 m have 0.48 m (trench 2)

Upper or Southern bed 3 is simple,has thickness of 0.30 m (trench 3).All three bed because of poor outcrop are traced at 45-50 m.

Besides,above the bazal sandstones of the upper Jurassic,in the basement of bands II-III are mentioned the beds of the Carbonaceous coal with thickness from 0.I0 up to 0.22 m (exp. III73).

Upper or Southern bed is simple and has thickness of 0.30 m.

In the same area in the basement of bands II-III,B.N.Androsov described two beds of coal.The low IY,has thickness of I.03 m and the upper Y with thickness of I.95 m contains rare interbeds of aleurolite and clay with thickness from 0.02 up to 0.I5 (summary thickness of rock interbeds is 0.2I m).

The bazarak coals are characterised by wide development of half-lustre and half--dull ash species.

Petrographic investigation of coal samples (see table) show the persistence of vitrinite content of 59-64%,fusenite-3-6%,semyvitrinite 8-I7%.The latter is represented mainly by disperse-ash homogenous mixtinite.

Vitrinite and coal in the whole do not show thermal action.Half-coke out of vitrinite has poorly-noticable signs of coal "F".But by the features all these coals most of all correspond to mark "C" with plastic bed of not more than I4-I6 mm.This is confirmed by the coking stage of coal metamorphism.

From mineral admixtures are distributed clays,quartz,rare pyrite,They are distributed regularly in coal mass and in the process of enrichment will contaminate the concentrate.The enrichment of coals of the coal manifestation is considered not lower than difficult.

Chemical-technical analyses also show that the Bazarak coals are closer to the coking than to fat.Thus, in less oxidised coals with moisture content of 2.96-3.65% the volatile yield amounts 24.4-25.9%.The more oxidised samples are characterised by more volatile yield - up to 29-33%.

All these data show that the coals of the Bazarak coal manifestation are the best by technological peculiarities.Most of all they correspond to coals of good mark "C".However the confining coal impregnation of the section and small thickness of coal beds diminish perspectives of the given coal manifestation.

Technical characteristics of coals of the Bazarak coal manifestation: (see Russian report,page 587).

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Roshag deposit (53,54).

The Roshag deposit has two areas,situated at the distance of 3.5 km from each other.

The Roshag-I area is situated in 3.5 km to the east-north-east from the well known deposit of rock salt Namakab (Or Takcha Khana),in the uppers of the Roshag sai.

The Roshag-I- area is located at the waterdivision of the Namakab and Farkhar rivers,represented the gentle hilled turffed space (about 6 km^2).From the north-west, east- and south-east this comparatively gentle part of the waterdivision is confined by steep cut slopes,where are well seen geological structure of this area.

The deposit area represents the extremely complicated tectonical structure(fig.I32 In large plan this is a gentle overthrust composed of the Jurassic rocks,overthrusted to the northern direction on the Pliocene (Rustak) deposits.In the limits of this overthrust are singled out several flakes:northern-"melange" out of gypsum,aleurolites and other rocks,mainly of the Kimmeridge-Titon (?) age,sometimes with blocks of oxford limestones.In the structure of this flake it is impossible to understand.Apparently, it was "lubrication" during the overthrust formation.The next one to the south flake i is composed by middle-upper Jurassic Terrigene deposits,laying in the overturned state and which form pseudoanticlinal,to the core of which is confined the described area of the Roshag deposit.The situated further to the south flake is composed by oxford limestones,slightly pinched out at the preceeding flake.

In the area of the Roshag-I (II40I-II42I) and to the south-west from it one can observe as the upper-Jurassic green-grey conglomerates,sandstones and aleurolites with bands of dense clays (band III of the Callovian stage) are changed by the laying gypsom metrically above by sandstones,aleurolites and dense clays,sometimes with coals of band II.Then,more above gypsometrically lay sandstones of the bazal band of I of the Callovian,which here form steep scarps.In one place on them lay the dense clays and aleurolites of the middle Jurassic.

In the deposits of band II of the Callovian stratigraphically above,here gypsomet rically below the bazal sandstones,in the core of pseudo-antyclinal,among aleurolites and dense clays had been recovered 3 beds of Carbonaceous coal.Below them the characteristics is given upwards in gypsometrical sequence (fig.I33).

Low bed (trenches I and 2) has complicated structure and represented by lustre fine-striated variaties,rare with interbeds of half-lustre variaties.Coal is heavily schistose.Thickness of coal bed is from 2.35 up to 3.8I m.Coal bands amount from I.47 up to 2.30 m with thickness of separate bands of interbeds from 0.04 up to 0.40 m. The bed has dipping to north-east with angle 50°,but in the adjacent trench it is already dipping to east-south-east with angle of 78°.

Middle bed (trench 7) has cimple structure and it is represented by lustre crumple Carbonaceous coal with rare lenses of black coaly clay of I cm in thickness.Thickness of coal bed is I.0 m.In the roof and soil of the bed there are dense clays.The dipping of the bed is north-east with angle of 30°.

Upper bed (trenches 3 and 4 and ,apparently, this bed in trenches 5 and 6) has complicated structure and recovered by trenches not completely.Its visible part has thi thickness up to 4.06 m; Carbonaceous coal amounts I.34 m.Separate coal bands have thick ness from 0.I2 up to 0.48 m.,interbed -from 0.I8-up to I.20 m The bed is dipping to the east with angle of I0-I5 $^{\circ}$.

All the beds are heavily corrugated and fractured.Apparently,separate coal beds of this upper bed are recovered in the South-West from it,in the right (p.II6I2) and left(pp.II429,II4I2) slopes of the Roshag valley,near bazal sandstones of the Upper Jurassic (band I).

The Roshag-II area is situated in 3.5 km to the North-East from the basic coal area,at the slope of the Farkhar river,where are exposed the deposits of the same conglomerate-sandstone-clayey band II of the Callovian,which have the dipping to the South with angle of 40°.Here in the rain channel is exposed the coal bed of simple structure with thickness of about 0.40 m (exp.II79I).

Thus,the total supposed area of distribution of coal-bearing deposits can be determined in 6 km^2.However all this space is covered by quaternary deposits and

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can be estimated only after the carrying out some corresponding mine- drilling works.

Coal beds of the Roshag deposit are composed by half-dull and half-lustre petrographical types with inconsiderable development of lustre coal.

The substance composition of organic part of the coal is characterised by high per percent of microcomponents of semyvitrinite group (23-26%) and fusenite-I8%.Vitrinite in one of the samples is equal to 69%,and in the other -do not exceed 50%.At some vitrinite grains can be noted a net of wedge-shaped jointings,snowing considerable coal oxidation.

Coal underwent thermal action,as vitrinite has slight whitish tint.

By metamorphism the coal can be referred to intermediate between fat high-metamorphised and coking metamorphised.In spite of the fact of favourable degree of metamorphism features of the Roshag coals do not correspond neither fat,nor coking.Vitrinite of the described coals,which is heated up to 600°,is also as izotropic as it seems to be in gas poorly caking coals.

Technical characteristics for coals of the Roshag coal manifestation:(see Russian report,page 591).

Petrographical characteristics for coals of the Roshag coal manifestation: (see Russian report,page 592).

Mineral admixtures of the Roshag coals are represented mainly by clays,gypsum and Carbonates.The most widelyare distributed clayey minerals.

The enrichment specially was not determined,but by the content and distribution of ash components in organic mass of the coal one can determine as medial.

Technical investigations confirm that the coals are oxidised to great extent.The moisture percent changes from 2.32 up to 4.70%.Coal with moisture of 2.32% corresponds to the volatile yield of 26.4%,and coal with 4.70% of moisture - 4I.7%.In the non--oxidised state the index of the volatile yield willbe not more than 25%.

Thus, in spite of the favourable petrographic parameters of the coal,the latter will not correspond by its features to coals of mark "F2 or "C".The coal will answer the low sort coals and can be used in metallurgical industry only together with good fat coal.

Namakab deposit (5I,52).

The Namakab deposit is represented by two areas:I and II.

The Namakab area-I-is situated at the left slope of the Namakab valley in 2 km to the South-West from the water corse of the same name river,in 3.5 km to the West from Zumchab village,which is situated above the river from the salt-rock deposit Takcha-Khana in 6-7 km.

The deposit area represents an overturned to the South-East synclinal folding,archly curved to the North-West (fig.I34).The north-west wing of the folding partially (in West and North) is cut by fracture. The beds at the wings of the folding are dipping to South-East from 30 to 55°.The length of the folding (by the bed of bazal sandstones of the Callovian,bandI)-4.5 km,the width- I.0 km.

Thedeposit area is formed by interbedding sandstones,dense,sometimes coaly clays and aleurolites of the non-dissected Low-Middle Jurassic,with the outwash(?) by the being covered bazal sandstones of the Upper Jurassic (Callovian,band I) with thickness up to 70 m.At the bazal sandstones conformably lay interbedded sandstones,clays and aleurolites of the Callovian (bands II-III,with visible thickness up to 450 m).In the basement of bands II and III of the Callovian section,in 50-80 m from its basement lays a coal bed of complicated structure of visible thickness up to 4.82 m;summary thickness of pure coal-is up to 3.90 m,thickness of separate coal bands ranges from 0.07 up to 2.50 m,rock interbeds from 0.04 up to 0.45 (fig. I3I,exp.II355).This bed is traced by trenches in the northern wing of antyclinal at 750 m without important thickness change

In the eastern part of the synclinal of the whole bed one cannot see the continuation of this bed because of the cutting of the wing of the folding by tectonical fracture.

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The Namakab area-II-is situated in I km to the South-East from the Namakab area-I in the same structure and on the same stratigraphic level (fig.I34).The coal manifestation is confined to central closure of synclinal structure.Coal bed here has also complicated structure (fig.I3I,exp.II353).Its thickness -I.25 m.It consists of two coal bands :upper with thickness-0.30 m and low -0.75 m,divided by sandstone with fine pebble,thickness-0.20 m.Coal bed is traced here at 25-30 m,in the side of small rain ch channel.Further to the South-West this bed is not traced because of the turfness.

Coal beds of the Namakab deposit are notable fot domination of half-lustre striped and indistinct-striped petrographical types and coal variaties. In the majority of the chosen and investigated samples distinctly is observed strong crumplness as the result of inner-bedded slippings and movements.

Substance-petrographical composition of coals by samples of separate beds is represented in the following table: (see Russian report,page 595.)

The content of ne-organic microcomponents is inconsiderable: 3-8% and only in one sample it reaches I8%. Vitrinite,as a rule,exists in quantity of 60-70%,which shows the comparatively favourable substance composition of the coal.Proceeding from the studies with microscope in polished sections underwent thermal action,which is apparently, connected with pressure and bed movements.

By metamorphism degree the coal belongs to the intermediate between the coking low-metamorphised and coking medial-metamorphised.

Technical analyses showed that the most part of the investigated samples,except one (II355)-I, is heavily oxidised .

Technical characteristics for coals of the Namakab coal manifestation is as follows: (see Russian report,page 596).

In non-oxidised coal the moisture percent is I.33%,ash-2.4%,volatile substance--I9.5%. This coal does not display the caking capacity- coke button - is powder like. Besides,the character of vitrinite of the heated coal is anizotropic by zones and allow to suppose that its coking features will be coke and emanciated. Thus, the Namakab coals,despite of the comparatively favourable petrographical parameteres, cannot be considered high-valued coking coals.

Oriented reserves of the Namakab deposit (by both areas) can reach 5 mln . tons. However there are no perspectives for considerable increase,as the structure of coal bed is confined by day surface (suspended).

Kishakton coal manifestation (55).

The Kishakton coal manifestation is situated in the valley of the same name spring which interflows into the Farkhar river from the left,against the place,where from motor-road Khanabad-Faizabad goes motor-road to city Farkhar.

Coal manifestation is situated at the right slope of the valley in the uppers of small sai under the name of Shakhton.

The area is poorly exposed,but by general geological data it is composed by bazal sandstones and conglomerates of the Callovian (band I) at which lay interbedded sandstones,aleurolites and dense,often coaly clays also of the Callovian age-Band II--III.The rocks lay monoclinally,with dipping to the North-West and West with angles of from 20-50°.On the ground of general monoclinal occurrence one can observe a number of fine foldings of sum-meridional strike,thank to the dipping sometimes becomes riverse.

Coal bed is confined to the basement of band II-III of the Callovian age,that is to say it occupies the same stratigraphic level,that is at the Namakab and Roshag deposits.

The bed is non-completely is exposed in the narrow rain channel only in one place (fig. I33,exp.XXXX II455); at the rest of the square this part of the section is covered by loesses with thickness up to I0-I5 m.The visible part of the bed with thickness of 2.44 m has complicated structure.The rock interbeds have thickness of not more than 0.06 m;their common thickness does not exceed 0.20 m The coal bed has dipping to the East with angle of 50-60°.

Considerable thickness of bed and its possible extension up to 5 km,as well as

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the existence of favourable relief for prospecting give the ground to recommend this square for searching-prospecting works for energetic coal.Possible reserves up to depth of 500 m one can wait within the limits of 2 mln. tons.

Microscopic and technical investigation of coal samples give the following picture.

Petrographical characteristics of coals of the Kishakton coal manifestation. (see Russian report,page 598)

Technical characteristics of coal of the Kishakton coal manifestation is the following: (see Russian report, page 599).

In substance composition is mentioned considerable content of fusenite -II-I4% and semyvitrinite (I6-I9%).Vitrinite is 56-62%.Vitrinite grains are with whitish tint,which shows the thermal action on coal.

Metamorphism degree is considered to be intermediate between coking middle- metamorphised and coking high-metamorphised (C1-Ch).

Mineral admixtures regularly are dispersed in the coal substance.Their quantity is small.

As showed the results of the technical analyses, the coal of the upper part of the bed is characterised by ashness of I9.6% and of low - I3.3%.

The moisture content in analysed samples is very high (I3.88-I4.00%),which is explained by deep oxidation of coal when occurring.

The volatile yield for the upper part of the coal bed amounted I7.4% and of the low part- 22.3%.Apparently,in non-oxidised coal taken beyond the oxidation zone,the volatile yield will not exceed I5 %.This shows that by features the Kishakton coals wil be emanciated and at the present time are of no interest fot metallurgical industry.

B. OTHERR USEFUL MINERALS.

COPPER AND POLYMETALS.

Scarn copper-polimetallic ore manifestation of the Darra-Alasang.

The ore manifestation consisting of several dissected scarn bodies is situated at the right and left side of the Surkhab river below the mouth of its left tributary of the Ishpushta river in I.5-2 km.

Zone of scarn rocks is situated at the contact of the Upper-Triassic-Low-Jurassic Granodiorite and Paleozoic schists with lenses and interbeds of marblised limestones, as well as at the contact of slightly metamorphised sandy-clayey Upper-Triassic deposits with the above mentioned paleozoic rocks.

Both granodiorites and sericite-chlorite schists,sandstones ,gravelites and argilites at the contact are changed to little extent. and thickness of zones of keratinization and contamination does not exceed I m.

the limestones underwent the process of scarnization.Scarn thickness depends on the lenses sections and interbeds of carbonated rocks.Separate scarn bodies are traced by strike up to 200 m,maximum thickness of them reaches 30 m.The scarns lay conformably with the enclosed strata-Azimuth of dipping -is 270°,angle 35-40°.

Scarns have zonal structure. Its character changes dependently on the lythological composition of the enclosed rocks.Thus,in the mouth of the Ishpushta spring the scarns are situated at the contact with diorites(fig. I35).In the exocontact of diorites one can observe: a) zone of fine-cristallic garnet scarns; b)magnetitic; c)coarse-grained garnet scarns; d) diopside scarns; e) marbles; f) cristallic schists.

Below is given the character of zonality in scarn body,situated at the contact of marbles and schists (left bank of the Surkhab river).

I. White marbles,middle-grained.

2. Diopside-garnet scarn.

3. Diopside scarn with impregnations of sphalerite,galenite,chalkopyrite,pyrrotine (sulphides irregularly change in different parts of this zone,reaching 5% visually).

4. Pyrrotine-diopside scarn.

6. Hornfeld rock,which preserves striped structure of schists.

5. Hornfeld diopside scarn with pirrotine and chalckopyrite.

7. Sericite-chlorite schists.

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Thickness of each separate zone changes in different limits: usualy it is measured by the first meters.

The basic ore minerals are: pirrotine,chalckopyrite,sphalerite,galenite,magnetite, besides, in small quantity are found: pyrite,markazite,ilmenite,martite,covelline,gematite,sheelite,cassiterite(?).The most distributed secondary minerals are malakhite and tserussite.

Below are given the results of spectral and chemical analyses of samples taken from scarns.

The results of spectral analysis of samples of the Darra-Alasang ore manifestation: (see Russian report,page 601):

The results of chemical analysis and spectrometry of samples of the Darra-Alasang ore manifestation (see Russian report,page 602).

Thecopper content amounts maximum of 6.60%,lead up to I%,zinc up to 30%,silver up to 0.0I%,tin up to 0.I%.Besides, in small quantity are mentioned: tungsten up to 0.0I%, gold -from traces up to I g/t.The ore manifestation is worth of carrying out the more detailed searching works for copper,lead and tin.However, there is no use of waiting here the deposite with considerable reserves of the mentioned metals.

Copper-polymetallic Ishpushta ore manifestation.(69,70,7I,72).

The manifestation is situated at the right bank of the Ishpushta.

The ore mineralization by quality composition is like scarn one and confined to zones of crushing and separate jointings in the Upper-Triassic sandstones,gravelites and conglomerates.The enclosed rocks lay here almost horizontally with dipping to the North,to the South with angle of 5°. Crushing zones oriented by various way (azimuth of dipping 20°,angle 60°,330°,angle $80-60^{\circ}$,vertical layings with azimuth of strike 320°, $20-40^{\circ}$,2I0,90°) have thickness which usualy does not exceed 2 m,the extension is about 30-40 m, rare their sizes encrease up to 30 and 200 m correspondingly.

Within the limits of these zones by numerous small jointings,sometimes made by quartz,in sandstones,gravelites and conglomerates are developed illinitions of copper green,near jointings in the rocks is observed finest irregularly distributed impregnation of the oxidised copper minerals.

The basic ore minerals are:khalckopyrite,pyrite,arsenopyrite,galenite,sphalerite, molibdenite.The secondary changes within the limits of separate zones of crushing were expressed in the formation of gypsyferrous iron hat,containing the secondary minerals of copper,iron , etc.

By spectral analysis in I0 samples was established the copper percent up to 3%, silver up to 0.0I%,zinc up to 0.3%,lead up to 0.I%,tin up to 0.03%,besides,small quantities of useful components are mentioned in sample No. 5055-g,taken from the crushing zone.

Results of spectral analysis of samples of the Ishpushta ore manifestation "copper sandstones".(see Russian report,page 604).

In the whole the area of mineralised rocks in interfluve of Garana-Ishpushta-Kaushandos amounts about I0 km^2.Within its limits the more detailed investigations are recommended.

The ore manifestation of grey ores of the Tanga-Ishpushta.

The ore manifestation is situated at the left slope of the Ishpushta river.The rocks which enclose the mineralization are the limestones of the Maastrikht stage laying with aximuth of dipping 0° with angle 45°.At this area they are jointed,thickness of the zones of crushing is about 0.2-0.6 m. Calcareous breccia by these zones is cemente with limonite,jarozite,copper green.In one of the samples(A) (fig.I36) which is traced at more than I00 m.Side by side with malakhite,azurite,limonite one can observe fine impregnation of grey ores.The latter are met also in the selvages of the zone,in limestones in 3-4 cm from the jointings.

In places of crossing jointings of different directions can be observed more intensive mineralization.

By spectral analyses in mineralised rocks was established the following percent of the following elements:(see Russian report,page 605).

Theore manifestation is of no practical meaning.

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General remarks.

Copper-polymetallic mineralization in the area of low current of the Ishpushta river has direct connection with near situated granodiorites.To mineralization were submitted all the Pre-Jurassic formations; depending on lythological composition is the extent of their mineralization. Lenses and interbeds of the carbonated rocks are scarned,their situation in lying side contact with granodiorites made unfavourable conditions for their deep exploitment by ore and scarn solutions,and comparatively rare distribution of them within the limits of the surrounding granites strata conditioned inconsiderable sizes of ore manifestation.

The favourable for distribution of the ore-bearing solutions were also slightly metamorphised,heavily jointed sandstones,gravelites and conglomerates of the Karn--Norij stages and jointed limestones of the Maastrikht which are situated at some distance from contact with intrusion.The character of mineralization is like with scarn one and it speaks of the fact that in all cases the mineralization genetically is connected with one spring,that is with granodiorites of the Upper-Triassic-Low--Triassic age.Thus, in searching respect here the zones of contact of the Upper-Triassic-Low Jurassic granitoides with terrigene-Carbonated rocks of the Paleozoic and Mesozoic are of great interest.

Aluminium (83).

The manifestation of bauxite-bearing rocks is situated in the uppers of Nalak sai,a little to the North-West from the Tala-Barfak villages. Here at the Upper-Triassi effusives of the medial composition is developed crust of weathering,apparently,of the Low-Jurassic age.In the plan it has mantle-like form of irregular contours and thickness,reaching I5 m.Above it is overlapped by the Low-Jurassic sediments.

Section of the crust of weathering is given in the following way :(downwards) (see Russian report,page 606).

The low part of the section with thickness up to 5 m (usualy 0.3-I.5 m) is represented by the ferruginizated brown rocks being transformed into gruss.On them are laying bleached lumpy dense clays.In some cases one can note primary structure of rock in them. Thickness of this bed does not exceed 5 m (usualy about 3 m) Above by the section lay dense clays of foliated-lumpy structure with fine oslites of ferrum hydro-oxides (thickness of interbed I.5-2 m).Further goes interbed (thickness 0.6-Im) Further goes interbed with thickness of 0.6-I m of red ferrous dense mergel-like rocks,on which lay grey foliated clays with fine ferrous oslites (thickness 0.5 m). Zonality is not always persistent.In most cases one can single out two zones in the cr crust of weathering : low,represented by different density of ferruginizated gruss of effusives of medial composition(thickness 5 m) and upper(approximately of the same thickness),represented by bleached dense kaolinisised rock,which contains fineoslites of ferrum hydro-oxides and sometimes preserve primary structure of the effusive.

In all cases is observed the certain regularity in the distribution of rocks saturated by aluminium oxide by section. The low and middle its parts contain the higher quantity of silica and ferrum.In theupper parts the content of aluminium oxide increases.Besides, the thickness of rocks,which contain its higher quantity,does not exceed 3 m.

From I8 samples the higher aluminium oxide percent is mentioned in the followi table (see Russian report,page 607).

While calculating for silicic modulus two of them are referred to low- ferriferou siallites,five - to low-ferriferous allites and one (sample 5I38) with cilicic modulus 2.62 is bauxite of mark B-5. The latter- rare-leguminous grey bauxite,formed by the rounded legums with diameter of 2-4 mm,consisting of bemite,cemented by cryptocristall line kaoline with bemite admixture.This rock lays in the form of a bed,with thickness of 2.5-3 m in the upper part of the section of the weathering directly under Jurassic coal-bearing deposits.Besides, the low part of the bed,containing bauxite is represent by allite-stony bauxite-like kaolinic clay.

Due to low percent of aluminium oxide,inconsiderable squares of the distribution of bauxite-bearing rocks this manifestation cannot be recommended for further detailed investigation. However this shows at the possibility of finding in this area more con-

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siderable accumulations of more qualitative bauxite.For the searching works can be recommended the area adjacent to the mouth of the Ashraf river (right bank of the Surkhab river to the Nort-East from Tala village).It is situated beyond the investigated territory,in connection with what had not been searched.
A number of areas can be recommended also beyond the square limits ,for instance,in the basin of the Geryrud river.

On the basement of the carried out works in first turn should be recommended the detailed works for searching bauxites along the left and right side of the Surkhab river in the area of interfluve Kaushandos-Ishpushta-Garan.

Molybdenum, Tantalum, Niobium (84,85).

Anogranite mass occupies square of about 20 km^2. It is situated in the area of the Arbab-Murat kishlak in the upper flow of the Tun-Darra river. The rock consists of oligoclase,quartz and kalishpat;in the form of fine impregnation is met fluorite, sometimes forming the accumulation of irregular form.Is also found molibdenite in the f form of rare accumulations.

By spectral analyses of three taken in different parts of the mass specimens of apogranites was established :(see Russian report,page 609).

Chemical analyses showd the percentage MaO No.I39I-I-traces ,No. I403-I-traces, No.I403-0.08I%; P_2O_5; No. I39I-I-0.0I;No.I403-I-0.0I3;No. I403-2-0.035.

The ore manifestation can have searching interest for Molibdenum,Niobium, Tin and rare elements within the limits of the mentioned mass of apogranites and in direct vicinity from it.

Celestine and Sulphur (88,89).

The manifestation of Celestine and Sulphur Dashti-Safed is situated in the area of Dashti-Saphed in the uppers of the Sari-Kucha river,of the left tributary of the Kamard river.Sulphur in this area had been known before and exploited by primitive method;At the present time the works in this area are abandoned, The rocks,which contain useful components,are confined to the lows of the Suzakian stage,the detailed s section of which is given above (see chapter "stratigraphy"). Productive bed is situate between the band of grey mergels (above) and gypsums(lower).The rocks gently are dipping to the North-West (320°angle,I8-20°) and almost non-dislocated.Thickness of the mineralised bed amounts approximately I.5 m.

Celestine and Sulphur are in the form of accumulation of fine crystals in emptiness and jointings,sometimes saturating the whole rock: here in considerable quantities are met barite,accompanying to the two basic minerals.Besides, all these minerals can form interbeds or be in the form of concretions among contaminated by gypsum mergels.By spectral analysis of five samples (No.7405-4a,7 405-4b,7405-4g,7405--4v) was established the content Ba from 0.3 up to 3% (strontium and sulphur had not been determined).

The manifestations and the area adjacent to them (XIX) can be recommended for carr carrying out more detailed searching-prospecting works. In respect of searching the ana logic deposits the perspective are the squares of the distribution of the Suzak formations,in particular,basin of the Madar and Chukri-Darra rivers.

Rock Salt (9I,92,93).

Within the limits of the investigated territory were described three manifestation of Rock salt : a) in 2 km to the West from Chal-Chal-I village; b) in 2 km to the East from Chal-Chal-II village; c) in the valley of the Namakab river,in 6 km above by the flow from Takcha-Khana Namakab village.

By its geological structure they are homogenous and that is why are described together. Saline dome (stocks) lay in the Upper-Jurassic heavily dislocated deposits of the Kimmeridge-Titon (?).The latter are represented by the interchanging of red-

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-brown,grey viscous clays,often contaminated with gypsum, of gypsums with interbeds and inclusions of clays and rock salt. Subjacent salt rocks are the clays:gypsum--bearing deposits overlap saline dome. Upper parts of it usualy are heavily contaminated with gypsum.Gypsum here is interbedded with rock salt,forming interbeds up to I m of strata.Thickness of this zone contaminated with gypsum does not exceed 5 m. Rock salt has red-brown colour,a lot of clay inclusions.Often is developed the striped tecture because of the interchanging of stripes of dirty-brown and dirty-green colour.

Rock salt in the area of Chal-I manifestation is traced in the side of the creek at not less than I km.Parameteres of the Chal -II are not known,as the surface of rock salt here is overlapped by Talus.Openings which are driven here by native population have depth about 20 m .

For the Namakab deposit the diameter of salt-bearing outcrop amounts about I500 m Visible recovered by the openings thickness of Rock salt amounts not less than I50 m. The content is determined in three samples,taken out of each manifestation.

For Chal-I pure salt amounts 84%;Chal-II -83%,Namakab-77%.

The low content limits the possibility of using the salt of the described manifestations in food industry without cleaning,and heavy dislocation of the enclosed rocks diminish their perspectiveness. In connection with this the described ore manifestations represent the limited commercial value.However under conditions of Afghanistan these deposits (in particular the Namakab deposit) is the only sourse of Common salt for the whole northern half of the country.

Limestones (94,95)

The limestones are used within the limits of the working area by wide distribution. In the form of separate beds and bands with thickness up to several hundred meters,they are located in the section of the Carboniferous Permian Upper-Jurassic,Upper-Cretaceous, Paleogene and less Neogene ages. The special interest represent limestones of the Dat--Paleocene age,which occupy several thousand km^2 of the investigated area surface. Thickness of them reaches 900 m,being at average by the area 300-400 m.Rocks have white,greyish,cremish,rare pink colouring.For them is typical aphanite,rare fine cristallic structure,indistinctly-bedded massive structure.Almostly everywhere one can observe the presence of different admixtures: clayey,silicic materials and etc. At some areas (for example, in the upper flow of the Kamard river and in the upper flow of the Elevator river among limestones are dolomite interbeds,and in places where the upper parts of the section are not eroded (area of Roshag village) here is mentioned clayness of high content. At the present time on the base of these rocks in city Pul-i-Khumri works cement plant.

The results of chemical analysis of limestones of different age are given in the table:(see Russian report,page 613)

Preliminary estimating the quality of limestones we can point out at the possibility of their usage as raw for making cement, building lime as natural stony materials and etc. In every separate case is necessary additional study.

Dolomites (96-97).

Dolomites within the limits of the investigated area are developed a little.They are met in the form of interbeds with thickness up to several douzen meters in the upper parts of the section of the Dat -Paleocene limestones. Besides they are observed among the deposits of the Cretaceous age near brick plant in city Puli-Khumri.

The results of the chemical analysis of dolomites are given in the table (see Russian report,page 613).

By composition the analysed rocks are close to chemical pure dolomites and from this point of view can find various fields of using.

For carrying out the searching-prospecting works for dolomites can be recommended distribution areas of the Upper-Jurassic,Cretaceous and Dat-Paleocene deposits. In particular, they are observed in the upper flow of the Elevator river,at the left bank of the Kamard river and in the area of Andau village.

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Marls (98).

Marls,marled limestones are mentioned mainly among the Cretaceous formations, except roughly-grained sediments of serie Red Grint.Besides, they are in composition of the Paleogene,Neogene and Quaternary deposits. In most cases they form well persistent beds of different thickness (from one-two up to several dozens meters).

From laky marls (band with thickness of about 20 m) in Darra-Sivak sai was taken sample No. 230, chemical analysis of it showed the following results: - 29.05; - 8.4I; - 2.99; CaO- 29.79; M -0-I.76.

Silicate modulus -2.5, aluminous -2.09.In case of using these rocks for making cement are necessary correcting extra.

Amphibole- Asbestos (99).

In medial flow of Saidi-Kajon sai the main effusives and green shists of the Low Carboniferous age are fractured by small body of ultra-basic rocks. The latter is fractured by majority of fine and more course jointings,irregularly branching forms with maximum thickness up to I m,made by Amphibole-Asbestos.The extension of such jointings reaches the first meters.

The manifestation,apparently, is of no commercial interest.

Talc (I00).

The manifestation of talc rocks is known in the upper flow of the Danai-Guri river Here metamorphic rocks of the Low Carboniferous age are fractured by small body of hyperbazites.The latter are heavily talc,and fine up to 3 mm,the jointings in them are made by chrizotile-Asbestos.The square of the talc rocks does not exceed I000 m^2. The manifestation,apparently, is of no commercial interest.

Clays (I0I-I09;II7-II9).

In the investigated area clays can be used as useful minerals,they are distributed limitedly.

The most ancient are the clays of remain crust of weathering,apparently , of the Low-Jurassic age,which lay at the outwashed surface of the Upper-Triassic effusives. They are distributed limitedly,with small thickness and changeable by composition. In connection with this they hardly can be of commercial interest.Interbeds of clays are met in the Middle-Jurassic coal-bearing band,but they are changeable by their granulometric and chemical composition that is ,apparently, the result of alluvial--laky-swampy genezise and formation in intermontane depressions of parts of sediment accumulation.And though at some areas these clays answer the demands of the industry as good refractory and ceramic raw is necessary to carry out more detailed their investigation for singling out commercial-valued sorts. Among the Upper-Jurassic formations(Oxfordian stage of the Dudkash area) there are separate clay beds,available for using as moulding raw,making of sewers, tile and brick.

Of practical use can be also red-brown,pale-yellow clays of Neogene age,widely distributed in the area and often used by the native population for building aims. They can be used also for making flush liquids.

Loesses and loess-like loams of the Quaternary age having wide distribution within the limits of the investigated territory,also widely are used by the native population for building aims;they are widely employed during making samanne and burnt brick.

Refractory clays (I0I,I02,I04,I05)

Clays which are the raw for making the refractories, are found in the area of Nalak sai.They are the remain formations of the low-Jurassic crust of weathering. In more details the crust of weathering ,its section and clay position is described above (see Alluminium).The described rocks form mantle-like deposits of unpersistent

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thickness (6-I5 m) and width (up to several hundred meters).Clays are red-brown,pale-yellow,grey foliated,containing sometimes a lot of fine oslite separations of ferrum hydro-oxides.As it was already mentioned from crust of weathering were taken and analysed I8 samples,three of which are of interest :

5080-3: O_2 -65.I5; A_2O_3 -25.28; $2O_3$ -I.29; CaO-0.35; MO-0.25;

5087-b: O_2 -42.53; A_2O_3 -42.66; $2O_3$ -I.49; CaO-0.7 MO-0.50;

5I36 : O_2 -55.70; A_2O_3 - 50.5I; $2O_3$ -0.99; CaO-0.39 MO-0.25;

Taking into account the low percent of ferrum,Cao and MO and higher content of alluminium one can suppose that analysed clays willhave refractory capacity,though the final conclusion is possible to make only after technological test.

In the area of Nalak sai is singled out perspective square for searching of refractory clays.

Moulding clays.

Clays available for using as moulding raw are found among the deposits of the Callovian stage in the medial flow ofDudkash sai.Bed is represented by grey,greenish-grey lumpy clays with thickness of about I3 m lays among limestones and aleurolites. By chemical analysis (sample No.I3) was established the content of aleurite fraction of 22.4% and clayey fraction -78.4%.By the results of these investigations one can suppose that clays are comparatively easily fusible and highly plastic .Apparently, they can be used as moulding raw with low thermochemical persistence ,besides, for making sewers and drenage pipes, tile and burnt brick.

Clays for flush liquid solutions.

With the aim of finding clays available for making flush liquid solutions were analysed seven samples from Neogene and Jurassic deposits. Available were clays of the Neogene age (Kaukpar-Nakhrin sai,sample 93-a) and Jurassic clays of the Raphak sai and Nalak sai.

a) Clay manifestation in the medial flow of the Kaukpar-Nakhrin sai (II7).

Band of red-brown,pale-yellow lumpy poorly gypsum and slightly sandy clays contains rare interbeds of sandstones and conglomerates. Thickness of clay beds is II-I7 m. Chemical analysis shows content O_2 -58.08; A_2O_3 -I5.73; O_3-2.99;CaO - 4.20; MO-4.78; granulometry: sandy fraction 0.6%,aleuritic - 75.5%,clayey-23.7%.Besides,were carried out phisico-mechanical investigations.These clays belong to medial-plastic calcio-natrium,well disperse in water.They can be used for making unheavy solutions and heavy solutions.

b)Clay manifestation in the upper flow of Raphak sai (II8).

Clays are greenish-grey with brown colouring,fat,bedded with interbeds of aleurolite and coal with thickness from 50 up to 5 cm.Thickness of clay bed is about 5 m . By age they belong to the Middle-Jurassic deposits.

Phisico-mechanical analysis of these clays (samples 3I83-4,3I83-I) showed that they belong to highly plastic calcio-natrium.They well disperse in water. They can be us used for making unheavy solutions and heavy solutions.

c) Clay manifestation in the upper flow of Nalak sai.(II9)

Clay is grey,light-grey,by places greenish-grey.It lays directly over coal-bearing band of Middle Jurassic and is overlapped by the band of sandstones and conglomerates . Thickness of the bed is 3.4 m,in foot (I.6 m)fat,in roof (I.8 m)slightly aleuritic. Analysis of sample 3402 showed that clay is highly plastic calcio-natrium,well disperse in water.It can be used for making inheavy flush-liquid solution of heavy solutions.

The works of flux party showed that clays are refractory.The results of the investigations of these clays are given in the corresponding report (Meshkovsky A.E. Dvornikov G.P.,I966).

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Gypsum (I09-II6)

Gypsums are met within the limits of the investigated area in the form of interbeds and lenses of different thickness (maximum - up to I5 m) in the Upper-Jurassic, Cretaceous and Paleogene deposits.The greatest interest represent the Suzakian gypsum-bearing strata and Upper-Jurassic. Interbeds of gypsums in the Cretaceous deposits are of small thickness and contain a lot of foreign admixtures (sandy material,limestones,etc.)

Five samples taken from different areas were submitted to chemical analysis. In all cases one can observe high percent of gypsum stone in rocks.

Gypsum manifestation in the Dudkash sai (II3).

Beds of grey,greenish,white gypsums having spotted colouring and bedded structure lay in the very upper parts of the Jurassic section,interbedding with clays,aleurolites,sandstones,dolomites.Thickness of gypsum interbeds usualy amounts I.5-2 rarely 5-6 m (at the upper part).Beds are persistent,usualy clayey,the upper ones contain wh white dense gypsum.Beds are persistent by thickness and traced by strike at I2 km. By chemical analysis (sample 40) was established the following content:
CaO_4 $2H_2O$-99.37%; O_2-0.20; A $_2$ O_3 -0.58; $_2$ O_3- 0.I2;CaO-33.24;M O -0.I4;

O_4 - 52.96; - 44.08 -20.50.

Gypsum manifestation in the Kamard valley (III).

Gypsum interbeds are situated among the Suzak clays and dolomites.Gypsum is white,grey,rare yellowish colour,sometimes half- limpid. In the low part of gypsum-bea bearing band the gypsums are of lumpy structure,above- they dense massive,interchangin with fine-bedded.The beddedness of the latters is conditioned by the interbeds (I-2mm) of clay-dolomite composition.Thickness of beds of dense gypsums amount approximately 2.5 m,of bedded -20-40 cm.The total thickness of the band is about 20 m. From its low part (interval 5-I2 m from the basement) was taken sample 358-a,chemical analysis of which showed the following results: Ca $_4$ $2H_2O$ -97.94; CaO -33.52, O_3 -45.55;

O_4 - 54.63 ; O_2 - 0.00; A $_2$ O_3 -0.25; O_2O_3 -0.30; M O -0.36;

K_2O_3 - 0.55 - 20.56.

Gypsum manifestation in the middle flow of the Ishpushta river.

In the right and left side of the river among the Suzakian clays and limestones which lay in the form of tectonic relic among the more ancient formations, is exposed the gypsum bed with thickness from 7 up to I5 m. Gypsum is white,dense ,by places jointed.Chemical analysis of the taken here samples (3378,3379) showed the high content of gypsum stone in rocks (in%):(see Russian report,page 62I).

Taking into account the high percent of gypsum stone in the rock,considerable bed thickness,persistence by strike and position near roads,it is possible to recommend the two first from the mentioned manifestation for carrying out more detailed investigations.

B. Heavy Concentrate sampling.

The aim of the heavy concentrate sampling was to find useful minerals by mechanical oreols of different mineral dispersion. To sampling were submitted modern soft all alluvial and alluvial-prolluvial deposits of the basic rivers and their tributaries.

In the whole at the area of survey in I4300 km^2 were selected 2058 heavy concentrate samples,that amounted I sample for 7 km^2.The low quantity of the heavy concentrate samples had been envisaged by the project and sanctioned by the leading organs in connection with aimed character of works (for coal) and little perspectiveness of

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the investigated squares in respect of possibilities of finding here considerable accumulation of ore useful minerals.

The selection of heavy concentrate samples was carried out from shallow holes with depth of not less than 0.4 m.Sample weight amounted 20-I8 kg. The heavy concentrate samples were washed in wooden pan up to grey heavy concentrate. Weight of heavy concentrates reached 2.5-I2.0 g,in average 6 g.

In preparation the heavy concentrates to mineralogical analysis were singled out: I) magnite fraction,which completely consists of magnetite. Its weight in average 0.2 g;2) heavy electromagnitic fraction,which consists of the following minerals:

Ferrum hydro-oxides -basic mass.
Epidote group 70-80%,sometimes basic mass.
Ilmenite -from rare signs up to signs, predominate rare signs.
Garnet-from rare signs up to I5-20%,predominate signs.
Chromite -rare signs,sometimes up to 30%.
Gematite -from rare signs up to 50%,predominate signs.
Pyroxenes-from rare signs up to 50%,predominate frequent signs.
Amphibole -from rare signs up to I5%,predominate signs.
Pyrolusite -from rare signs up to I5%,predominate 3-5%.
Turmaline,biotite,leucoxene,siderite-rare signs.
Fraction weight in average amounted 0.5 g.
3) Heavy non-electromagnitic fraction,which consists of the minerals:
Barite- frequently basic mass.
Circon-from signs to basic mass.
Rutil-from rare signs up to basic mass.
Celestine -from rare signs up to basic mass.
Apatite -from frequent signs to 50%,fraction weight,predominate the first percent
Leucoxene-from rare signs to 30% of fraction weight,predominate signs.
Andalusite -to 30-50%of fraction weight,predominate the first percents.
Sheelite-from rare signs to the first percents,predominate signs.
Lead elements(galenite,vulfenite,cerusite,suric,vanadinite,pyromorphite)-from rare signs to frequent signs,predominate signs.
Copper minerals(cuprite,malachite,chalcopyrite -from rare signs to frequent signs predominate signs.
Sphen-from rare signs to 70% of fraction weight,predominate signs.
Diopsides-signs.
Torite-from rare to frequent signs,predominate rare signs.
Sphalerite-from rare to frequent signs,predominate signs.
Anataze,cinnobar,monacite,gold,fluorite,ortite,cassiterite,basobismutite,pyrite, brucite,korund -rare signs.
Fraction weight in average is 0.03 g.

By results of mineralogical analysis was singled out a group of useful minerals , which represent practical interest; cinnobar,lead minerals(galenite,vulfenite,cerussite, suric,vanadinite,pyromorphite,sheelite,minerals of rare lands (xenotism,optite,monacit gold,fluorite,copper minerals(cuprite,malachite,chalcopyrite),torite,torocircon,baso-bismutite,sphalerite,cassiterite,phosphorite,collophen.Therest of minerals are distributed either isolatedly or everywhere,without noticeble regularities (for example, barite,celestine).

Dispersion oreols of useful minerals were singled out on the base of anomal quantity of heavy concentrate samples with the content of one or another useful mineral at comparatively limited area (river basin or its tributaries).Also was taken into account the quantitive content of useful mineral in every sample.

In the whole were singled out 22 dispersion oreols (from I up to XXII).

On the map of useful minerals these minerals and their oreols of dispersion are pointed out by corresponding colours (see legend to the map of useful minerals).

Cinnobar - in heavy concentrates is met in isolated signs (up to I4), in the form of grains up to 0.2-0.4 mm. By the area it is distributed irregularly and confined,apparently, to fracture zones.One can single out four dispersion oreols:

a) the upper part and middle flow of the Askhorak river(5).Here are pointed out

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isolatedsigns of mineral in 7 heavy concentrate samples. There is no anomal contents. The oreol square is 55 km^2.

b) the upper part of Djalk sai,northern slope of the Margozar ringe.Here cinnobar is present in 4 heavy concentrate samples,in isolated signs.The oreol square is about 20 km^2.

c) the upper part and middlr flow of the Larkhab river(I7).Cinnabar here is mentioned in 8 heavy concentrate samples.The contents are represented by rare signs.The o oreol square is 40 km^2.

d) the middle flow of the Kamakab river(2I),in the area of the Kori-Bash sai. Cinnobar here is mentioned in 8 heavy concentrate samples and in heavy concentrates is present from isolated up to frequent signs (hevy concentrate 289).The dispersion ofeol is not concluded and the square is approximately equal to 22 km^2.

Gold- is met rare and in small quantities(not more than 5-I3 signs),its grains up to 0.I-0.7 mm.It forms inconsiderable dispersion oreol to the East from Ishpushta village (I2), in the area of Kaushandos sai.The oreol is confined to scarn zone. Gold is present in 4 heavy concentrates, in isolated signs.There is no anomal contents.The square of oreol is equal to 25 km^2.

Sheelite-is mentioned in heavy concentrates,selected basically near intrusions, with which it is connected genetically.As to the quantity it is represented from rare signs to 2I.5 g/m^3 (sample 7II5).

Dispersion oreols of Sheelite are situated:

a)right slope of the Saigan valley (8) from the mouth yp to middle flow. Sheelite is met almostly in all selected heavy concentrates.In quantitive respect the mineral is met from rare signs up to the first percents.Anomal content was found in heavy concentrate 7II5-2I.5 g/m^3 . The oreol square is about I20 km^2.

b)the uppers of the Ishpushta river (I2) and Siogak-Tanga sai. Here the mineral is observed in I4 heavy concentrate samples with sheelite content from rare signs to the first percents.Anomal contents are pointed out in samples: 334I,3374,3329 - -from 0.22 up to 0.64 g/m^3.The oreol square is approximately equal to 40 km^2.

c) middle and upper flow of the Siakh-Darra river(I4).Sheelite is mentioned in 35 heavy concentrate samples,in quantity from isolated signs up to weight contents- -0.2-I.2 g/t (3065,3057,3524).This oreol is confined to the square of granitoids distribution.

d) area of the Larkhab and Piez-Kul rivers(I5),where is mentioned the presence of sheelite in 90% of selected heavy concentrate samples.As to quantity the mineral is represented from rare signs up to the first percents.Anomal contents are mentioned in samples 3524,3057,3063 and 3093 -from 0.2 up to I.8 g/m^3.The oreol square is about 250 km^2.

Torite,Torocircon at the investigated square is met rare-in the area of the Tun-Darra river (3 heavy concentrate samples) and in the area of upper and middle flow of the Larkhab river (I6).Here the mineral forms the dispersion oreol,where it is observed in I4 heavy concentrate samples from isolated to frequent signs.Frequent signs of it are pointed out in samples : 3568,3034 and 3535,3563.The oreol square is about 90 km^2.

Torite is also met in the area of the Chal and Ishkamysh rivers.The mineral here is observed in I4 heavy concentrate samples from isolated up to frequent signs.The frequent signs are observed in samples 220 and 246.It does not form distinct dispersion oreol.

Copper minerals-Cuprite,Malachite,Chalcopyrite- are met rare in isolated signs a and only in sample 57-b the content reaches 0.2 g/m^3.

On the map of useful minerals are mentioned two dispersion oreols.

a) in the area of the Ishpushta river (II) - from its mouth up to the upper part. Minerals of copper are met in the form of isolated signs in II heavy concentrate sampl There is no anomal contents.The oreol square is about I00 km^2.

b) in the area of the exploitation of coal in Karkar and Dudkash (22),where copper minerals are found in 7 heavy concentrate samples,from rare up to frequent signs. Frequent signs are observed in samples 37 and 57-b.The oreol square is about 50 km^2.

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Lead minerals-vulphenite,galenite,cerussite,suric,pyromorphite,vanadinite.

Minerals of this group are present in most of heavy concentrate samples,taken at the investigated square,in quantity from isolated signs up to I2.5 g/m^3 (sample59-e) and I6.5 g/m^3 (sample 300).

Lead minerals form a number of dispersion oreols,situated:

a) in low flow of the Darrai-Suf (I),above the coal deposit Dakhani-Tor and in the area of coal deposit Shabashek(#5).In this oreol of dispersion lead minerals in association with sphalerite are present in all heavy concentrate samples,from rare signs up to the first percents.Anomal contents are mentioned in samples:3767,3769 and 3777 - from 0.2 up to 0.7 g/m^3.The oreol square is about 400 km^2.

b)right side of the Saigan valley(8).Here also almostly in all samples are present lead minerals,from rare signs up to the first percents.Anomal contents are mentioned in samples :7II5,7II6 and 7II7 -from 0.II up to 4.3 g/m^3.The oreol square is about I20 km^2.

c) area of the Garana,Ishpushta and Kaushandos rivers (I0).The majority of heavy concentrates are mentioned by minerals of this group.Quantitively they are represented from rare signs up to the first percents.Anomal contents in the oreol are observed in samples : 3346,3373 and 3324 -from 0.03 up to 0.4 g/m^3. The oreol square is about II0 km^2.

d)Area of Sary-Assia village (4); by II heavy concentrate samples are mentioned lead minerals.Quantitively it is expressed by frequent signs.Anomal content is mentior in sample 37I4-0.5 g/m^3. The oreol square is about 50 km^2.

e e)area of Doab and Shakhpasand villages and Askhorak and Charmak rivers (6), where in all heavy concentrates are present lead minerals from rare signs up to the first percents.Anomal content is mentioned in samples 3I69,3692 and 3684 - from 0.I4 up to 4.5 g/m^3. The oreol square is approximately I50 km^2.

f)Karkar and Dudkash area (I9).The presence of lead minerals is mentioned in 8 heavy concentrate samples -from 0.3 g/m^3 in sample 300I up to I2.6 g/m^3 in sample 59-e.The oreol square is about 50 km^2.

g)area of Bidan,Fosilpered,Djzhetalar saies in 5-6 km to the South from Nakhrin village (I8).Lead minerals here are mentioned in 7 heavy concentrate samples from solitary signs from 0.09 g/m^3 (sample 3873).The oreol square is 6 km^2.

h)middle flow of the Namakab river (20).Lead minerals are present here from soli tary signs up to I6.5 g/m^3 (sample 300).Anomal contents are also observed in samples 290,294,296,297 from 0.06 g/m^3 up to I.5 g/m^3.The oreol square is not closed from the South and equal to 75 km^2.

Sphalerite is met from solitary up to frequent signs usualy in association with lead minerals.The dispersion oreol of Sphalerite is mentioned in the area of Dakhani--Tor,in low flow of the Suf-Darra (2),where its frequent signs are observed in I7 heavy concentrate signs. Quantitively Sphalerite in the oreol is expressed from solitary up to frequent signs.The oreol square is about 80 km^2.

Sphalerite is also observed in heavy concentrate samples in the middle flow of the Namakab river.Quantitively it is represented here from solitary signs up to 4.9 g/m^3 (sample 300).It does not form dispersion oreol.

Fluorite is met only in five heavy concentrates in solitary signs in the area of Pashagol and Pundara rivers.

Basobismutite in heavy concentrates is met rare.Quantitively it is expressed by signs.It is confined to intrusions.It does not form the dispersion oreols.

Arxenopyrite is met only in six heavy concentrates.Quantitively it is represented by solitary signs.It does not form dispersion oreol.

Minerals of rare lands: Xenotim,Ortite,Monacite.

Rare signs of minerals of this group are mentioned in small quantity of heavy concentrates,selected near intrusions.It does not form dispersion oreols .

Cassiterite- solitary signs are found in I4 heavy concentrate samples; only in one sample (sample 2I5)- frequent signs. It does not form dispersion oreols.

Phosphorite- frequent signs are met in 4 heavy concentrate samples by the left slope of the Khovtar-Khona river.

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Collofan is met very xxxx often in heavy concentrates.Quantitively it is expressed from solitary signs up to basic mass (sample 3178).It does not form dispersion oreols.

The shown on the map of useful minerals the dispersion oreols,apparently, of no practical interest.However, they should be taken into consideration during the further geologo- prospecting works at the investigated territory as well as the adjacent territories with analogic geological structure.

C.Metallometric sampling.

Metallometric sampling was carried out at the whole territory of surveying works. Samples (rock fragments) were selected along geological routes withcut certain system Special attention was paid to zones of alternated and mineralised rocks,zones of crushing, quartz veins,intrusion contacts etc.

In the whole were analysed 2950 samples. As the result of this appeared to be possible to single out a number of areas,where in the rocks are preserved the heightened quantities of useful minerals.These areas are mentioned on the map of useful minerals by the corresponding signs of ore manifestations.The most interesting area is the basin of the Ishpushta-Kaushandos rivers,within its limits is recommended to carry out more detailed works.

Here by metallometric sampling was established the higher content of polymetals: copper up to 5%,lead up to I%,zinc up to 5%,silver up to 0.0I%,tin up to 0.I%, molibden up to 0.03%,vismut up to 0.0I%,cadmi up to 0.03%,gold up to I g/t.Besides, the heightened content of polymetals is mentioned in samples selected near Kara-Kotal pass,in the uppers of the Malak creek,at the left side of the Nakhrin river and near Khodja-Khizir village,in the uppers of the Badam-Darra creek.

Areas with heightened content of copper are found also in the Kalai-Murat valley by the Chenarak creek,in the uppers of the Shindarra creek.Copper percentage here by results of spectral analysis reaches 0.3%,silver up to 0.003%.

In sampling apogranites situated in the upper flow of the Tudara river was found the presence of niobium (up to 0.03%),tin (up to 0.003%),molibden (up to 0.3%), lantan (up to 0.06%),itrium (up to 0.0I%).These rocks only because of their limited distribution cannot be good objects for carrying out more detailed works.

Thus, in spite of the absence of system in selecting metallometric samples and using the half-quantitive spectral analysis,as the result of the carried out works was established a lot of ore manifestations of useful minerals. Besides, one coped to find out geo-chemical background for some species of intrusive rocks (see chapter Intrusive rocks).The given results speak of the fact that this type of work is insufficiently resultative.During systematical sampling and using the more exact quantitive spectral analysis, as the result of metallometric sampling can be given more interesting results.In particular, was compiled map of geo-chemical oreols, were found geo-chemical peculiarities of different composition and age rocks.

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Chapter IX, U N D E R G R O U N D W A T E R S

Hydrogeological conditions of the coal-bearing areas of the north-eastern part of territory of afghanistan as various as particular moments of their geological development,modern landscape and extent of moisture.

Paleozoic rocks which underwent intensive folding and metamorphism, multiple faultness and magmatism,are consolidated in unic hydrogeological massive. Its waterproof ability is determined mainly by fault extent and directly unconnected with the age of rocks.This allowed to refuse from age dissection while describing hydrogeology of the Paleozoic.

Tectonical fault which represent water-leading channels cut the Paleozoic rocks in direction of basic tensions in massive.Lythological category is turned to be subordinated to tectonics,though the creek charge,that is extent of water proof ability, depends upon the rock composition.

At the square of hydrogeological massive is singled out unic water-bearing complex of metamorphic rocks of the Paleozoic with waters;

I.Zones of local tectonic and exogene jointing.

II. Regional tectonic faults -channels.

Mesozoic and Tretiary deposits form bed-water-bearing structure.Rock age,their composition and tectonics are valuable for estimation of conditions of formation of the underground waters.They are studied only for the first time and mainly by creek drenage system.

Detailness of mapping the water-bearing ability of sedimentary rocks is possible mainly,in the volumes of systems and rarely of divisions and suits.The attached hydrogeological map by conditionality is close to scale I:I 000 000 (made on the base of I:5 000 000) and can be considered to be reviewal one.

I.Waters of metamorphic complex of the Paleozoic.

Waters of the ancient metamorphic strata are mainly distributed at the north--East of the considered territory,within the limits of folded platform frame.In its central part,at the left side of the Surkhab river the square of their distribution is less.At the south-west by the right slope of the Surkab valley though there are wide fields of the Paleozoic rocks, the natural discharges of underground waters were not observed (see hydrogeological map),which allowed to refer this area to waterless squares.

Classifying the natural discharges of underground waters from the Paleozoic rocks, one can notice among them the two main types by confiness and discharge capacity. One the most numerous group of springs is met in the uppers of creek valleys,sais and relief forms like them.They are such springs as: in basin of the Piez-Kul river (660,697),in the upper part of Shurau sai,Kaphkhana,etc. (I420,3548,352I).Their discharge capacity is usualy not great,not more than 0.2-0.3 l/sec.The influence of the lythological composition of rocks is well seen.In the field of distribution of schists of the Siadarian suite the spring discharge as arule is counted by one hundred part l/sec Among limestones of the Durumbakian suite are met springs with discharge 0.2-0.5 l/sec.

Another part of springs has no distictly expressed connection with certain relief elements.Some of them are confined to the lowest marks of one or another drenage system others -to high levels of interfluves.(XXXXX) For example, springs to the south-east from Fulul village (I0993), in Dzhupel-Dai sai (I37I) and to the east from Doabi--Shakhpasand village.(853I).Springs of this group are notable for high discharge up to I0 and more l/sec.Lythological peculiarities of water-bearing rocks here are also counted but in less degree.Thus, in Dzhupel-Dai sai the spring which is confined to metamorphic schists, has discharge of 2.0l/sec.

(see Russian report ,page 649,649a)

The main difference between the springs of the both groups is because of permeability of rocks,being formed by different processes by type and scale.The observations showed that the springs of the second group in all cases are connected with coarse channels of tectonic zones,stretched at large distance.They are situated not only in the

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field of the Paleozoic but far beyond its limits,connecting water-bearing systems of different types.The background of the regional endogene water-leading net is the finer net of local meaning.Genetically it is conditioned by the processes of denudation and local tectonics and is in certain connection with regional net.On this fact show chemical composition and mineralization of underground waters. In separate cases the mineralization of waters in rocks of Sifdarian suite,for example,background mineralization of waters of the Paleozoic complex of rocks is located within the limits of 0.3 -0.4g/l. As we can see on the gydrogeological map, the waters of heightened mineralization can be formed as the result of migration of waters and salts from the distribution area of the Jurassic and Triassic by the cross-cutting the Jurassic,Triassic and Paleozoic rocks tectonical channel-fault.Chemical composition depending on mineralization constantly little by little changes from hydrocarbonated calcic up to Sulphate Natrium-Magnium according to the following scheme: (see Russian report,page 650).

Ground water recharge takes place by complicated ways.In analogical geotectonical conditions the main role plays modern landscape and the corresponding climate peculiarities.To the North-East from Dashi village the squares of ground waters distribution are close to high mountain Khodzha Mukhammad ringes,which for a long time are under favourable conditions of moisture.The formed underground waters constantly migrate to the North,within the limits of the concerned areas.Consequently,at the area of the north-eastern field of the Paleozoic rocks one can single out regional and local recharge of ground waters with predomination of the regional recharge.

At the left bank of the Surkhab river the role of the regional recharge is more important.Water resorses of this territory are filling up for the sake of water inflow by tectonical channels from inner-platform recharge field (Doabi-Shakhpasand).However, the recharge here is scanty and as the result of this the underground waters are distributed not everywhere,especially at the interfluve of Kaion-Surkhab and in the low part of Kaion river.

Underground waters of metamorphic rocks are of little practical meaning.They are used for water-providing in dayly life and agricultural production in the Nakhrin area,Ishkamysh and other settlements. In dry seasons of a year these waters are the main source of river and creek recharge. At last they are filling up resourses of underground waters of young deposits,adjacent to mine structures.

2. Waters of the Triassic deposits.

Water-bearing complex of the Triassic deposits is represented by the Terrigene rocks and it is distributed at the confined areas in the uppers of the Alma,Doab,Kaion rivers,as well as in the Nakhrin area (effusive massive) and at the left bank of the Farkhar river. In the Surkhab valley among the Triassic deposits is not seen any water manifestations and they are referred to waterless (see hydrogeological map).

Water-collector features of the Triassic rocks were formed under conditions of yet non-consolidated separate parts of marginal platform zone and geosynclinal field.

The strong manifestations of the Late-Triassic -Low-Jurassic vulcanism and moveness of ground crust in the Triassic and Post-Triassic period brought to degritation and cementation of sedimentary rocks.Because of this the modern their permeability has jointed character. Besides, the water-bearing complex is slightly touched with denudation processes and the main ways of accumulation and migration of undergrour waters are represented by tectonical channels. By the only jointing-veined type of permeability of rocks one can explain considerable spring discharge,reaching 10l/sec, with typical multitudes 0.5-1.0 l/sec.

In some places the rock composition does not influence upon the springs.B c. Kampirak)p.82),for example,among argillites was observed spring with discharge 2 Of 10.0 l/sec. In the same area,a little to the South from spring 82 among aleurolites and argillites acts spring with discharge 1.0 l/sec (p.7298).Only Effusives are characterised usualy by very poor water manifestations.The discharge of the confined to them springs is counted by one hundred parts l/sec.,reaching under favourable conditions 0.1-0.2 l/sec.

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Chemical composition and mineralization of underground waters in the Triassic deposits are various.The total mineralization changes within the limits of 0.3--2.8 g/l., and chemical composition -from hydro-carbonated calcium up to sulphate magnium-calcic or magnium-natrium. In the cation group the most widely distributed is Natrium-ion, and with mineralization elevation (except p.II804) it occupies the leading place. Magnium most of all is located between Natrium and Calcium.

Changing of chemical composition depends from mineralization: (see Russian report, page 653)

In contrast to the given hydro-chemical row,which is typical for the south-west and central areas,chemical composition of waters of north- eastern area is characterised by hightened meanings of Chlore and Calcium.This reflects the peculiarities of lythologo-facial position of overcrossing Triassic of the Jurassic deposits,with which here are connected the Rock salt and Gypsum deposits.

Therecharge of the Triassic water-bearing complex takes place mainly at the expence of overflowing the waters from the overlying Jurassic and Cretaceous,Cretaceous--Paleogene rocks. One can notice that in the South-western area in the uppers of the Alma river and doab with the Triassic complex are connected everywhere fresh waters.This is expressed by the fact that the main role in filling up the water resourses of the Triassic deposits play waters of the Cretaceous-Paleogene limestones,the aboundance of which and low mineralization are mentioned by all springs.At the left bank of the Farkhar river (p.II804) in the Triassic complex takes place direct overflowing of waters by tectonical channel from the deposits (see hydrogeological map).The analogical phenomena are observed and in the Nakhrin area and to the east from Dashi village (the Piez-Kul valley).Because of the gypsum and saltness of the Jurassic and Cretaceous deposits to the north-east from Dashi village ,the waters of the Triassic deposits everywhere have the heightened mineralization.

Practical importance of the Triassic deposit waters is limited. At the present time they are used in Sary-Assia,Doabi-Shakhpasand ,etc (the uppers of the Alma, Doab rivers).In future they can be used while exploitation coal deposit Sarry-Assia. Waters of the heightened mineralization in central and north-eastern areas represent interest from the balneological point of view. (p.I66,82,7298,II804).

3. Waters of the Jurassic deposits.

Water-bearing complex of the Jurassic is represented by alluvial-laky continental coal-bearing deposits with predomination in sections of slightly permeable clayey, clay-sandy,clay-conglomerate specimens.To the North-East from Dashi village the water--bearing rocks become gypsum and salt-bearing. At the Khanabada and Farkhara interfluve the water-bearing complex contains limestone beds.

On the surface the Jurassic water-bearing complex discharges in Kamach-Shabashek ,Sarry-Assia-Doab areas,in the area of city Puli-Khumri,Nakhrin village and in basins of the Namakab,Farkhar rivers.

In the Saigan valley and further by the left bank of the Surkhab river among the Jurassic deposits the water manifestations are not met,and they are referred to waterless. (see hydrogeological map).Waterless sections of the Jurassic are met in the uppers of the Dzhauzari (Kamard),Alma and Doab rivers.

In contrast to the Triassic Jurassic deposits were not submitted to complete degidration and cementation.Tat is why among them are widely distributed soft or poor cemented rocks,forming rock medium of water ground migration.Nevertheless,the tectonic faults are shown distinctly and in such rocks. These faults are the ways of underground water drenage and by them one can determine certain connections of the Jurassic water--bearing complex with underlying and overlapping complexes.Among the limestones and gypsum deposits of the Farkhar-Namakab interfluve the tectonical channels are the main ways of underground water drenage.

Spring discharge reflects the difference in character of water conductivity of the Jurassic rocks.Springs of pore waters,well studied at the coal deposits of the Shabashek and Sarry-Assia ,as well as in the area of city Puli-Khumri, have discharge 0.0I-o.I l/sec (p.6.6I,etc).In the same rocks,for example, at the Sarry-Assia deposit

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but being faulted by tectonical movements,spring discharge increases up to 0.5-0.61/sec (p.I2). In the north-eastern areas the springs,confined to tectonical channels are characterised by discharges 0.3-0.7 l/sec.One spring at the right bank of the Chal river situated near foot of limestone outcrop has discharge 350-4001/sec(p.1050I). In this place the river valley is crossed by coarse tectonical zone,stretched to the West-South-West with azimuth of about 260°. Here the drenage ways have carst-tectonic character.

Chemical composition of underground waters of the Jurassic deposits changes from hydrocarbonated Magnium-Calcic while mineralising about 0.4-0.5 g/l up to Hydrocarbonated-Chloride Natrium while mineralising I0.5g/l.Change of chemical types and subtypes takes place in general case according to the following scheme :(see Russian report, page 656).

Beyond the given hydrochemical row is chemical composition of springs in pp. 4730 and 7I60 (in the Darrai-Suf valley).It is notable for high importance of Hydro-Carbonate -ion.While elevating the mineralization the quantity of hydrocarbonates does not fall,but proportionally increases. Sulphate-bearing of waters is low. Grapho-analytical constructions allow to suppose that hydro-carbonate-ion is in anion group at the first place within the limits of water mineralization I0.5 g/l,leaving the place for Chlor-iOn.Even during the mineralization I0.5 g/l its content is only 8 mg-equiv. less than Chlor content.Spring 7I60 gases by carbonic acid gas.Apparently, the formation of these waters directly is not connected with the Jurassic water--bearing complex.At this fact points out the manifestation of Carbonic acid gas, untypical for waters of the Jurassic deposits.Usualy they gas by hydrogensulphide (pp. I73,I050I,etc) and by methane (p.I73).In the Dzhiar-Tebar area before (S.A.Popol and S.V.Grom,I954) had been described oil discharge spring.The investigation showed that this was not oil,but gas.Gas discharge is not great;gas penetrates from jointed argillites,easily flames,extinguishes with difficulty.

The recharge of the Jurassic water-bearing complex takesx place mainly at the expence of overflowing of waters from the more ancient and xxxx younger strata. Under favourable conditions,for example,in the area of the Shabashek,near contacts with Cretaceous water-bearing deposits are met water-abundant springs of fresh waters, which point out at such recharge (p.I3).Rising water xixxx drenages of the Triassic complex recharge by tectonic channel the Jurassic water-bearing complex at the Sarry--Assia deposit (p.I2).In interfluve of the Chal and Farkhar rivers the main role in the recharging the Jurassic water-bearing complex ,apparently, plays the water discharge from the field of hydrogeological mass of the Paleozoic.

Practical meaning of water-bearing capacity of the Jurassic deposits is determined by coal-bearing capacity and envisaged exploitations of coal deposits. Hydrogeological study of the deposits showed that the productive horizons either drained or they are located among waterless rocks.Possible water drenages at the Shabashek and Sarry-Assia deposits are estimated in 25-I00 m^3/sut.Because of poor water and as a rule of heightened mineralization of waters the Jurassic water-bearing complex cannot be the source of water-providing of mining enterprises.

Mineral Carbonic acid gas,Hydrogen Sulphide and Hydrogen-Sulphide-Methane waters can represent only balneological interest.

4. Waters of the Cretaceous and Cretaceous-Paleogene deposits.

Water-bearing deposits of this age are represented by different in composition rocks.Among the Cretaceous predominate poorly permeable clayey sandstones,interbedding with argillitesand clayey-sand conglomerates.All the rocks are poorly cemented. The Cretaceous-Paleocene is represented by limestones.Thicknesses of deposits correspondingly change within limits to 800-I500 m and 400-700 m. They form two separate water-bearing complexes.

For the whole section of the Cretaceous and Cretaceous-Paleogene deposits are typical waters of tectonic faults-channels. They are distributed,mainly,in the interfluve of Alma-Doab and Dzhauzari (Kamarda) and in the uppers of the Kaion river and by the Surkhab valley in the area of city Puli-Khumri.Solitary springs of these

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waters are met in the Saigan valley (pp. 5787,6345).The large squares in the Dzhauzari (Kamard),Alma,Doab valleys, in the Kamach-Shabashek,Nakhrin ,etc. areas are waterless (see hydrogeological map).

Spring discharges which recharge by the waters of the Cretaceous ,Fine-Paleocene deposits,change in wide limits :0.2-200.0 l/sec.In most cases it is counted by several l/sec. In the Cretaceous-Paleocene limestones by zones of tectonic faults under favourable conditions take place carst processes,forming the high-permeable medium of underground water migration.Spring discharge of the confined to carst limestones, is counted by dozens and hundreds l/sec (pp. I63,3645,I746 and etc.)Such springs recharge creeks and small rivers,being the source of water for water-providing and irrigation of many populated points.

Chemical composition of waters is different.In central part of south-western area this is Hydrocarbonated calcic low-mineralised waters.In the Surkhab valley and further to the North-East mineralization of waters increases and water composition changes yp to chloride Natrium.

Among the waters of geightened mineralization are distinguished two types.In waters of springs 562,I68,498I,I67 the predominating anions are Sulphates and Chlore In two points (springs I68,I67) this is thermal waters.At the left bank of the Surkhab river in city Puli-Khumri water of spring I67 have 35°, and near Toty,to south-east from Baglan in I5 km water springsI68 are characterised by 25°. The high water temperature of these springs allows one to suppose the presence of abyssal fracture in the Puli-Khumri area,which crosses the Surkhab valley and connects the Cretaceous-Paleocene water-bearing complex with thermal source,situated in interior part of the earth of the Paleozoic folded complex.Rising discharges of warm waters form a kind of thermal zone (see hydrogeological map).

In springs I66 and 6345 were found waters,in which with the elevation of mineralizationis observed proportional increase of Hydrocarbonates and Chlore.Waters of spring 6345 emanate free Carbonic acid gas.

One can suppose that in the formation of waters of one or another type take part abyssal processes,which are beyond the Cretaceous and Cretaceous-Paleocene. strata.

Represent interest also Chloride-Sulphate thermal and Carbonic acid Chloride -Hydrocarbonated mineral waters.At the present time they partially are used by native population for curing skin diseases.In city Puli-Khumri near spring I67 are built several simple barriers,where people can take bathes.Mineral waters of the Saigan valley are used also for cattle treatment.

5. Waters of the Tretiary deposits.

I the section of the Tretiary deposits is singled out the water-proof complex of the Suzak and Shafai suites, represented mainly by clays and sandy-clayey species with rare inclusion of pebble.and also water-bearing complex of the Madrian, Koshtangian and Rustakian suites.Water-bearing complex of distribution in the Dzhauzary valley (Kamard) at the left bank of the Surkhab river,in the interfluve of the Surkhab and Nakhrin and also in the Khanabad valley. The water-bearing complex,compos only by limestones and partially by the Terrigene ppecimens of the Madrian suite, is distributed at the interfluve of the Dzhauzari (Kamarda) and Saigan and has thickness of about I50 m; in the area of the Shabashek and in the uppers of the Doab river it is represented mainly by conglomerates of the Rustakian suite,and in the North-East -by sandy-conglomerates formations of the Koshtangian and Rustakian suites with thickness up to 3000-4000 m and more.

At the large areas in basins of the Alma,Doab,Kamard,Nakhrin ,etc. the Tretiary deposits are waterless (see hydrogeological map).

Water-bearing deposits of the Koshtangian and Rustakian suites are represented mainly by poorly cemented and soft rocks,among the Madr rocks predominate tectonicall faulted limestones.Because of this are formed waters of pore type and carst tectonic channels.

Springs,which are recharged by the waters of the Tretiary deposits are usualy of low discharge.Typical discharge maltitudes change from 0.0I-0.3 l/sec.

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Only in three places (pp. 8085,I2055 and I30) the spring discharge reaches I.5-4.01/se All these springs are confined to poorly cemented conglomerates of the Rustakian suite.One can suppose that among the Tretiary deposits the most permeable watered are the formations of the Rustakian suite.

Chemical composition of waters and mineralization are various. Predominate the waters of the heightened mineralization.Mineralization limits are 0.26-37.8 g/l. As we can see in the Tretiary deposits are met the most mineralised waters.

While investigating the chemical composition our attention is drawn by the high water sulphate.In counted quantities Sulphates are appeared (more than 25%-equiv. during mineralization of 0.4 g/l and further their content increases in proportion up to maximum mineralization 37.8 g/l. Though Chlorides under this mineralization stay at the first place,but Sulphates leave them place only II mg/equiv.that is to say 2%.In cation group Natrium accompanies Sulphate.Magnium usualy occupies intermediate position between Natrium and Calcium.

The overfilling up the resourses of the waters of the Tretiary deposits takes place both in the period of atmosphere sediments and by natural overflowing of the underground waters of the deposits of another age.

Practical interest the waters of the Tretiary water-bearing complex represent only in the north-eastern areas.
In spite of the high mineralization they are used for domestic needs as the waters of better quality are absent (see hydrogeological map).

6.Waters of the Quaternary deposits.

Waters of the Quaternary deposits inthe process of the survey specially were not studied,as it needed artificial recovery.The carried out observations allow to suppose that ash-talus complex is waterless everywhere.Piedmonte trains of Prolluvium-alluvium complex and alluvium of river valleys is water-bearing.In the Khanabad valley at the right slope is traced the whole serie of springs. Ishkamysh and other villages are based on the use of these waters.

7.Waters of igneous rocks.

Water-bearing rocks of the igneous complex are distributed sporadically,mainly, in the field of the Paleozoic water-bearing complex (see p.I0279,I0895,550 and other tables)
They form with it unic drenage system of underground waters.Only one spring 20033 is met among diorites,surrounded by sedimentary deposits of the Triassic and Neogene.It is situated in 8.5 km to the South-East from Surkh-Kala village and ,apparently, is recharged by the waters migrating by regional tectonic channels of central part of the South-West area.The springs met at the square of the hydrogeological mass have discharges limited by 0.I-0.5 l/sec with good quality of water. In one case I0895 the spring discharge reaches 3.0 l/sec.

Waters of the igneous rocks are transitive.Their recharge and chemical compositio completely are determined by resourses and water composition of the inclosed complexes

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C O N C L U S I O N

As the result of the carried out geologo-surveying and searching works in I963--I965 of a scale I: 200 000 was studied the geological structure of the large territory at the nothern slope of West Gindukush with square of more than I4 000 km^2. The investigation of this square allowed to get a number of new interesting data,which deepene the understanding of the geological structure and hystory of development of northern Afghanistan.

The structure of the investigated territory is reflected at a number of correspending maps:

I. Geological map (on the topo-base of a scale I:1 000 000) accompanied by four summary stratigraphical columns and sixteen geological sections.

2. Map of useful minerals (on the topo-base of a scale: I: I 000 000) combined with water-points map.

3. Ten scheme geological maps of a scale I:50 000,enveloping areas of coal deposits and coal manifestations.

4.Tectonical map of a scale I: 300 000.

5.Geomorphological map of a scale I: 300 000.

6.Hydrcgeological map of a scale I: 500 000.

Geological report preserves necessary data for complete characteristics of the area geological structure.They are accompanied by photos,drawings,correlation schemes and other graphical materials.

The basic results of the carried out geologo-surveying works are concluded in the following:

I. Was made sufficiently detailed stratigraphic dissection of the developed at the studied square deposits,from the Proterozoic (?) up to the Quaternary.

a) Proterozoic (?) and Paleozoic.For the first time at this territory though conditionally were singled out the Proterozoic formations (Fululian suite).Was established stratigraphic sequence in strata of the Paleozoic deposits,divided at the Siadarian suite (low Paleozoic),Durumbakian suite (indissected Silyr-Devonian), Tundarian suite (indissected upper-Devonian division -Turneian stage),Viseian stage, Kalaimuratian suite (middle and upper-Carboneferous divisions),Farkhar suite (indissect Carbon),low-middle Paleozoic indissected,upper division of Carbon-low division of Permian,Sakmarian -Artinian indissected stages,Sakmarian stage,low-Permian division. Many of them for the first time were approved paleontologically (Durumbakian,Tundarian suites,Viseian stage and ,etc.)

b)Mesozoic.Among the Triassic vulcanogene-sedimentary deposits are singled out middle and upper divisions,subdivided at a number of suites and stages.Some of them (Karnian-Norij,Rattian stages) are approved paleontologically.The Jurassic deposits ar represented by the three divisions.Thelow and middle divisions are divided at some suites,upper-at some stages. Was established coal-bearing capacity of some suites. Cretaceous deposits are dissected at some subdivisions,from Neokomian-Aptian of the indissected stages up to the united ones of the Dat stage-Paleocene.

c)Kainozoic. Paleogene is divided at the Suzak,Alai-Turkestan stages and Shafai s suite of the upper Oligocene-Miocene. Neogene is dissected at some suites of the Miocene and Pliocene.Among the Quaternary deposits are singled out four divisions, composed by different genetical types of deposits.

2. The investigated intrusive rocks refer to the Carboniferous Upper-Triassic - -Low-Jurassic and Upper-Jurassic intrusive complex,being divided at fases.

3. The hystory of the development of the investigated territory is represented in the following way:the accumulation of the Proterozoic (?) formations in geosynclinal conditions,their folding and metamorphism at the end of the Proterozoic. Geosynclinal development of the whole described area in the Paleozoic epoch,folding in the Variscian epoch.In the Triassic and Jurassic the field feels half-platform stage of the development. In dissected troughs are accumulated vulcanogene deposits of the Triassic,and then flyshoid-like deposits of the Jurassic. At the end of the

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Triassic (with simultaneous intrusion of intrusions) and at the end of the Jurassic (also accompanied by intrusions) they are crumpled into foldings. Since Low-Cretaceous epoch begins the persistent platform regime.However, in the Mesozoic-Kainozoic complex of the platform mantle are observed a number of surfaces of interval and unconformability;the deposits themselves are crumpled into cover foldings and together with the foundation are broken by fractured faults.These dislocations reflect fases of the folding,having place in the situated in the vicinity the Alpian geosynclinality of Beludzhistan-Gymalai.

Extent of the Early-Alpine and Alpine reworking of the Paleozoides increases in d direction to the North-East ,where they represent already ancient (the Variscian) core within the limits of the Alpine geosynclinality.From the West it is limited by marginal trough,filled by thick strata of the Neogene roughly-fragmented formations and pinched out within the limits of the investigated territory. Correspondingly in the investigated territory are distinguished four main structure-tectonical zones,pictured on the tectonic map:

I.Variscian folded formations.

2.Mesozoic plate.

3.Ancient (Variscian)mass in the Alpine geosynclinal field.

4.Alpian marginal trough.

4.Geomorphological investigations allowed to single out the main morpho-tectonic t types of relief,establish their age and main stages of relief formation,finding out their connection with the Late-Alpine and Neo-tectonic movements.

5.Searching works were of complex character.At the same time great attention was paid to the study of coal-bearing capacity and finding the coal deposits.The investigated territory envelops the north-eastern part of North-Afghan coal -bearing basin, for the first time singled out by the authors of the report.

As the result of the carried out geologo-surveying and searching works was established perspectiveness of some areas of the investigated territory in respect of different useful minerals and for the first turn of coal.Was established the confiness of coal-bearing capacity to deposits of the Upper Triassic and Jurassic.

Coals of the Jurassic age refer mainly to mark "Gh" and they are good energetic co

Coals of the Upper-Triassic age can represent interest for searching of the marks of caking coals.

One can distinguish four coal-bearing areas (from the West to East): Darrai-Suf, Saigan-Ishpushta,Puli-Khumri and Chal-Namakab ,

The most productive both in respect of reserves of energetical coals and determination of coal marks available for coking is the Darrai-Suf coal-bearing area. Here we pointed out eight perspective squares for more detailed searching-prospecting works (from I up to YIII).

Puli-Khumri area represents interest in connection with its position near motor roa Puli-Khumri-Kabul;At the present time mainly from this place to Kabul and other cities of central Afghanistan are taken coals of common purposes.Here are envisaged two perspective squares for carrying out in future the search-prospecting works.(IX and X).

Chal-Namakab coal-bearing area with eight (IX-XYII) envisaged squares for more detailed search-prospecting works represents interest in connection with possible development here of chemical industry on the base of the rock salt deposit and etc.

Saigan-Ishpushta coal-bearing area because of the lack of coal reserves in future will not represent practical interest.

The total quantity of the envisaged perspective squares for the search-prospecting works for coal amounts I7 with total square of I30 km^2.On the whole investigated territory and within the limits of "perspective" squares was estimated and studied 60 manifestations and coal deposits,48 of which were manifested for the first time as the result of the carried outhere the works.The description of coal manifestations and "perspective squares" is given in section "Coal-bearing capacity" of the chapter "Useful minerals".

Besides coal, was also studied and estimated 60 manifestations and deposits of ore and non-metalliferous useful minerals.A lot of them were discovered for the first time. Were established the manifestations of Copper,Polymetals,Alluminium,rare metals

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(molibden,tantal , etc.),Celestine ,Sulphur,Amphibole-Asbestos,Talc,refractory Clays, moulding and other,were investigated the rock salt deposits,limestones,dolomites and marls.For some manifestations of polymetallic mineralization (Ishpushta,Darrai-Alasang and others)was established probable connection with intrusions of diorite and quartz diorites of the Upper-Triassic -Low Jurassic age. Rare metal mineralization is connected with apogranites of the same age. The rock salt deposits in the Chal-Namakab area are confined to the Upper-Jurassic (Kimmeridge-Titon) deposits.

Were envisaged IO perspective squares for more detailed search-prospecting works f for Sulphur and Celestine,rock salt,Gypsum,refractory clays (XYIII-XXYMI) with total square of 72 km^2.

The description of these squares and recommendations by them are given in the corresponding sections of chapter "Useful minerals".

As the result of the carried out heavy-concentrate sampling were established oreols of mechanical dispersion of such useful minerals as Cinnobar (4 oreols),Lead minerals (9 oreols),Zinc minerals (I oreol),Sheelite (4 oreols),Copper minerals (2 oreo gold (I oreol), and Tori (I oreol).

In total were singled out 22 dispersion oreols with total square of about I800 km^2 They represent the independent squares for more detailed search works,or approve the areas of discovered ore manifestations,or does not represent any interest. In the latter case they are connected with certain springs where is hardly to wait for industrial concentrations.(For example,Sheeliteis connected with granitoids where it is as accessory mineral,etc.).The oreol description is given in the corresponding section of chapter "Useful minerals".

Metallometrical investigations allowed to determine a number of manifestations of useful minerals,such as Lead,Copper,Tantal and others. In one case was approved and contoured perspective square for Copper (XYIII).

All the investigated manifestations and deposits of useful minerals,"perspective squares" and dispersion oreols are put on the attached map of useful minerals.

6. Hydrogeological investigations at the territory of coal-bearing areas of the north-eastern afghanistan were carried out for the first time. The collected data allowed to characterise the underground waters of the large heavy-populated part of the country and to make hydrogeological regionality.At the hydrogeological map are show areas of distribution of fresh and mineralised underground waters,and waterless squares In Puli-Khumri area is distinguished zone of hydrothermal waters.

The main type of underground waters fot the most part of the country is jointed-veined connected with regional tectonic faults.

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LIST OF LITERATURE

A. Published works.

VLASOV N.G. Main features of the Pre-Jurassic history of South-Western Darvaza . Geology of Middle Asia.Collection of Sinitsyn,LGY,I96I.

KAFARSKY A.X. Stratigraphy of the Low-Silyrian deposits of Peter I ringe.Materials of the Pamirian geology,publ.I,Dushanbe,I963.

LEVEN E.Ja. To stratygraphy of metamorphic strata of Northern Pamir.Izvestie of higher educational institution.,Geology and prospecting,NoII,I960.

MELAMED Ja.R. Boundary between the Neogene and Quaternary periods in Tadjic xxxxxg depression. Report of Academy of Science of Tadjic SSR,volume YII, No. 9,I964.

TERNER F
FERHUGEN Dzh. Petrography of igneous and metamorphic rocks. IIL,Moscow,I96I.

PETRUSHEVSKY B.A. Paleography and tectonics of Afghanistan and Tadjikistan. Academy of Science,publ. 8,serie 3,I940.

BARTHOUX J. Notes geologioues sur l' Afghanistan.R.Congres Soc.Sav. I933.

BOUREAU E.
FURON R.
ROSSE L.F. Contribution a l'etude des flores jurassique d'Asie.I.Le plateau Iranien.Mem.Museum Hist.Nat.Paris,XXX,f.2.I950.

BRUKL K. Über die Geologie von Badakhchan und Kataghan (Afghanistan).N.Jb. f.Miner.,Bd. 74,Abt. B.I935.

DESIO A. Riognizioni Geologiche nel'Afghanistan.Boll.Soc.geol.Ital.,vol.LXXIX fasc. III, I960.

FURON R. Notes prelliminarle sur la geologie de Som.Soc L'Est de l'Afghanista Geol. Fr. I923.

FURON R. L'Hindou-Kouch et le Kabolistan (Contribution a l'etude geologique est geomorphogenique de l'Afghanistan).Paris,I926.

FURON R Sur la geologie de l'Hindou-Kouch et du Pamir.Bujj.Soc.Geol.Fr., (5), IY. I934.

FURON R. Geologie du plateau iranien (Perse,Afghanistan,beloutchistan).Mem. Mus. Hist. Nat., nouv ser. YII.

FURON R. Contribution a l'etude du Trias en Afghanistan.Bull.Mus.Hist.Nat.
ROSSET L.F. Paris, 2 ser., XXIII, 5. Paris, I95I.

FURON R., Le Jurassique au Nord du Plateau iranien, Afghanistan,Prospection
ROSSETL.F. a Karkar (pres Poul-i-Khomri).C.R.Ac.SC.Paris.CCXXXIX. I954.

GABERT G. Zur Geologie des Gebietes von Karakar (Nordost-Afghanistan).Bull. Afghan.Geol.Min.Surf.,N I.Kabul, I964.

GRIESBACH C.L. Afghan Field-Notes,Rec.Geol.Surv.India,XYIII, pt.1.Calcutta, I885.

"_"_" Field-Notes from Afghanistan (No.3),Turkestan.Rec.Geol.Surv.India, XIX,pt.4.Calcutta, I886.

HAYDEN H.H. The Geology of Northern Afghanistan.Mem.Geol.Surv.India,XXIX.I9II.

HERBORDT O. Ueber die Aussichten Afghanistan als Bergbauland.Int.Bergwirschaft, Jahrg.,H. II/I2.I926.

HINZE C. Die geologisdhe Entwicklung der östlichen Hindukuch-Nordflanke (Nordost-Afghanistan).Bull.Afgh.Geol.Min.Surv.,N I Kabul,I964.

JACOB K.
SHUKLA B.N. Jurassic plants from the Saigan series of Northern Afghanistan and their palaeogegraphicalsignificance.Pal.Indica,30,N 2.I955.

LAPPARENTA A.F. de Sur une nouvelle serie antepaleozeique en Afghanistan.C.R.Som. Seanc. geol.France. Paris, I962.

"_"_" La serie stratigraphique de La vallee de Kahmard (Hindou-Kouch,Afghanistan). C.R.Acad.Sc. t. 256, Groupe 9. I963.

"_"_" Observations stratigraphques sur les series precambriennes de l'Afghanistan.C.R.Acad.,Cci., 254, IO. Paris.

MENNESSIER G. Lexique stratigraphique intenational,3,Asia,Fasc. 9a,Afghanistan. Paris,I I960.

Scanned by:Dip.Eng.M.Ismaiel Malek

POPOL S.A.
Tromp S. — The stratigraphy and main features of Afghanistan.Proc.Kom,Acad.Wet., Ser.B, N 57,N 3.Amsterdam, 1954.

Seward A.C. — Mesozoic plants from Afghanistan and Afghan-Turkestan.Palaeontologia, Indica, IX. 1912.

Thompson M.L. — Permian Fusulinids from Afghanistan. Journ. Palaeontologia,20,No. 2. 1946.

TROMP S.W. — Detailed description of stratigraphic standard sections in Afghanistan (Annexe II. Kon.Nederl.Wetens Proc., Ser. B,57,N 3, 1954.

WEIPPERT D. — Zur Geologie des Gebietes Doab-Saighan-Hajar (Nord-Afghanistan).Bull. Afghan Geol.Min.Surv., N I. Kabul, 1964.

B.Reports (of the Departament of Geology and Mines,of the Departament of Oil,etc

ANDROSOV B.N.
KUDRIASHEV N.S.
SAIDALIKHODZHAEV G,N.
MARSHANSKY I.I. — Report of geologico-prospecting works at the Shabashek coal deposit in 1963-64. Vol. I-III,Kabul, 1965.

BRATASH V.I.
PECHNIKOV V.V.
SHAKHIDZHANOV JU.S.
NAUMOV V.S. — Geological structure and perspectives of oil-bearing of the Khulm-Kokcha interfluve.(Report of geologo-surveying works in a scale of I : 500 000, carried out in the Kunduz area in 1959-61),1961.

BRATASH V.I.
EGUPOV S.V.
PECHNIKOV V.V.
SHELOMENTSEV A.I. — Geology and perspectives of the oil-bearing capacity of Northern Afghanistan and adjacent areas of the USSR.Vol.I-II,Moscow,1964.

IVANOV S.D.
NAUMOV V.A.
CHERNYSHEV I.V. — Geological structure and perspectives of the oil-bearing Kortaisn and Khanabadian structures.(Report of geologo-structural survey in a scale of I:500 000 - 1962),Mazari-Shariff,1963.

IVANOV S.D.
NAUMOV V.A.
CHERNYSHEV I.V. — Geological structure and perspectives of the oil-bearing Ambarian Khwadjaian and Madzharian structures in Katangan province of Northern Afghanistan.(Report of geologo-structural survey in 1963) Mazari-Shariff, 1964.

KAZAK Ju.M.
LAPKO F.F.
TOLSTUKHIN E.A.
KORETSKY M.S. — Report of geologo-prospecting works at the Farindzhal Barite deposit in 1963-1964 and of the searching-prospecting works at the Tanga-Murch Celestine deposit in 1964.Vol.I-III,Kabul, 1966.

KUDRIASHEV N.S.
SANZHALOV A.T.
ANDROSOV B.N. — Report of geological works carried out by the coal-prospecting party in Northern Afghanistan in 1965.Vol. I-III,Kabul,1966.

KUSOV I.K.
SMIRNOV M.S.
RESHETNIAK V. — Report of the results of the searching-prospecting works for iron ores in Central Afghanistan with reserve calculation by the Khadzhigak deposit for 1963-64.Vol.I-III,Kabul,1965.

MESHKOVSKY A.E.
DVORNIKOV G.P.
MAKHNEV A.M. — Report of geologo-prospecting and searching- reconnoitring works for accessory non-metaliferous raw for ferrous metal industry, carried out in Northern Afghanistan in 1965 in accordance with contracts 640 from 24 of November,1962 and 1378 from 20 of December,1965, Kabul, 1966.

Scanned by:Dip.Eng.M.Ismaiel Malek

MAKHNEV A.M.
SHAKHIDZHANOV Ju.S.
MELEKHIN V.I.
SUTIAGIN V.A.
DMITRIEV O.

Geological map of the Pul-i-Khumri area.Scale I:253 440,1962.

MIKHAILOV K.Ja.
KULAKOV V.V.
KOLCHANOV V.P.
PASHKOV B.R.

Report of geologo-surveying works for coal in a scale of I:200 000.Herat province (parts of sheets -4I-IX,-X,-XI,--XYI). Vol.I-II,Kabul,1965.

ROSHCHIN V.F.

Scheme tectonical map of the Mesozoic deposits of Northern Afghanistan.Scale I: 500 000, 1964.

KHATISKATSI G.N.
DERTEV A.K.
PASHKOV Ju. V.

Report of the work of thematical party for 1962-63 on the theme "Stratigraphy,lythology and collector features of the Meso-Kainozoic deposits by the reference sections of the north-eastern areas of Afghanistan". Mazari-Shariff,1963.

"-"-"-"

DRATH A.

Possibilities and the means of development of coal-mining in Ghorband valley and Ishpushta.Barfak region.Kabul,1939.

"-"-

Instructions for the geological and prospecting works in Kar-Kar Region. Kar-Kar, 1940.

"-"-

Development and progress of the geological and exploration works in Kar-Kar region. Kabul, 1941.

FOX E.F.

Summary report on the preliminary mineral reconnaissance in Badakhshan. Kabul,December 26, 1937.

GHULAM MOHAMMAD

Coal mines. Kabul, 1946.

HINZE S.

Vorschlag zur Aufschurfung von Kohleflozen bei Cal nahe Iskames (Kataghan) mit 2 Anglagen. Kabul,1962.

Mc GUIRE,H.R.

Ishpushta Coal Mine. 1947.

SANFORD R.S.

The Ishpushta coal mine and the proposed modernization program,Ishpushta,Afghanistan, 1950.

SIEBDRAT H.

Bericht uber die Ergebnisse einer Befahrung des Kohlen--revieres von Darra-i-Suf im Oktober 1961.

"-"-"-"

Bericht uber die Ergebnisse von Gchurfarbeiten im Kohlenrevier Dahan-i-Tor (Darra-i-Suf) vom Oktober 1962.

WALSH M.A.

Ishpushta Coal. 1950.

WEST W.D.

Final report on the Work of the Government of India's coal survey in Afghanistan , 1940-42. 1942.

Scanned by:Dip.Eng.M.Ismaiel Malek

LIST OF GEOGRAPHICAL NAMES

Adzhar
Aibak
Akrabat
Akchashma
Alamly
Alimdzhan-Khan
Alla-Vuddin
Alma
Amir-Omad
Amu-Daria
Angurak
Andarab
Andarak
Andau
Askhorak
Askhorak-Bala
Arfa-Kul
Akhkotal
Akhengaran
Ashraf
Baba
Babali
Baglan
Badam-Darra
Badakhshan
Badzhgakh
Bazarak
Balkhab
Bamian
Bangi
Bandi-Amir
Bandi-Zardcharu
Bandi-Mazar
Bandi-Shaudan
Barfak
Bulola

Vodu
Eastern Pamirs
Vuch Margau
Gazistan
Garmak
Herat
Gorband
Gur-Darra
Dana-i-Shira
Dandan-Shikan
Darvaza
Darra-i-Alasang
Darra-i-Alma
Darra-i-Garmak
Darra-i-Guri
Darra-i-Kazhak
Darra-i-Karaz
Darra-i-Kolon
Darra-i-Sivak
Darra-i-Suf
Darra-i-Terra
Darra-i-Top
Darra-i-Shu
Darjai-Chal
Daut
Dakhana
Dakhan-i-Top
Dasht-i-Rubo
Dasht-i-Safed
Deg-i-Mirsalam
Dzhalid
Dzhangalak
Dzhar-i-Sokhta
Dzhar-Tiba
Dzhauzari
Vodu
Eastern Pamirs
Dzhau-Palar
Vuch Margau
Gazistan
Garmak
Herat

Dzhiar-Tebar
Dzhupel-Dai
Doab
Doab (Tangi)
Doab-(Tatar)
Doab-i-Mekhzarin
Doab-i-Shakhpasand
Dashi
Dudkash
Durumbak
Zamburak
Zandokul
Western Gindukush
Zarinul-i-Kal
Ziper-Kul
Igargu
Irmalik
Islam-Darra
Isfandzh
Istoma
Ishkamysh
Ishak-Chag
Ishpushta
Ishukan
Kabul
Kady-Sai
Kainar
Kaion
Kalagai
Kalai-Murat
Kalu
Kamard
Kamach
Karamkul
Kampirak

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Kandakau
Kara-Kotal
Kara-Chatyr
Kariz
Karkar
Kasaban
Kaukpar-Nakhrin
Kau-Shandos
Kaf-Darra
Kaftarkhana
Kafkhana
Kashka
Kidzha-Ramadan
Kishakton
Kokcha
Kotal-i-Marak
Kotal-i-Sabzak
Kotal-i-Sahfed
Kotal-i-Chal
Kunduz
Kukh-i-Akhan-Komar
Kukh-i-Bechezan
Kukh-i-Gisar
Kukh-i-Dzhaukar
Kukh-i-Ishpushta
Kukh-i-Kargazi
Kukh-i-Kargam
Kukh-i-Namakab
Kukh-i-Takhte Chingiz
Kukh-i-Khasani
Kukh-i-Shekh-Dzhalal
Kusharcha
Kush-Darra
Kyzyl-Dzhink
Kyzyl-Kala
Larkhab
Lela
Lorak
Lorandzh
Madr
Madrak
Mazar-i-Sheriff
Marak
Mush-Khona
Nai-Dzhabit
Nalak
Namak
Namakab
Namak-Sai
Narjau
Nakhrin
Ob-i-Shur
Pandzhsher
Paropamiz
Pashagol
Pili
Pitovak
"Passed"
Poi-Tangi
Pul-i-Khumri
Piez-Kul
Rafak
Regbulak
Roshag
Roshag-i-Bolo
Rud-i-Zamburak
Rud-i-Mandarra
Rud-i-Namakab
Rud-Chal
Rud-i-Shurau
Rui
Sabzak
Sabzak-Bandi
Sadmardi
Spid-i-Kaion
Saigan
Saje-Beshgazd
Salang
Samangan
Samandao
Sangach
Sang-i-Abdulgashti
Sang-i-Liashm
Sandzhitak
Sargala
Sarry-Assia
Sarry-Dzhas
Sarry-Kainar
Sarry-Top
Selsela Kokh-i-Band-i-Baba
Siakh-Darra
Siakh-Kukh
Sia-Kash
Sia-Darra
Suk-i-Darra
Surkhab
Surkh-Kala
Surkh-Komar
Surkh-Shar
Taikhavol
Takatuimas
Takkhar
Takcha Khana
Tala
Talukan
Tangi
Tang-i-Muruch
Tang-i-Nakhrin

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Tersak-Chashma
Tir-Band-i-Turkestan
Toga-Shamar
Tol-i-Mozer
Totu
Tuzan
Tuzguny-Tereskai
Tun-Darra
Turmush
Tutak
Umakai
Farand
Farkhar
Ferozak
Fulul-i-Bolo
Fulul
Khadzhazait
Khadzhigak
Khazara Sai
Khalivberdy
Khanabad
Khanurkharan
Khauz
Khashirmaikh
Khodzha-Bina
Khodzha-Gandzh
Khodzha-Lagman
Khodzha-Muhammad
Khumadzha-Bina
Khushk-Dara
Khulm
Chakau
Chal
Changau

Charmak-Sai
Chaul-i-Khana
Chakhar-Dekh
Chakhil
Chashma Gavan
Chashma-i-Polu
Chashmai-Sahfed
Chashm-i-Shir
Chenarak
Cher Chenar
Chinor-Darra
Chikhil-Dukhtaban
Chokak-i-Bibi
Chor-Kushta
Chor-Chashma
Chuk-i-Darra
Shabashek
Shamar
Sharmar
Shar-Shar
Shatu
Shekari
Shekari gorge
Shisha-Valang
Shibar
Shingan
Shulesh-Darra
Shulukta
Shurau
Egiriz
Elevator
South-western Darvaz
Jakni-Kul

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No.	No. on the map of useful minerals	Name and location of deposit or manifestation of useful minerals	Coordinates of eastern longitude and northern latitude	Enclosing rocks and their age	Form of occurrence of useful mineral, sizes, mode of occurrence	Data concerning composition and quality of useful mineral. Results of analysis (in %)	Practical value and recommendations
I	2	3	4	5	6	7-8	9
	HARD COAL						
I.	I	"Lela-I".Lela sai in I3--I5 km up-stream the Chor--De river from the Danitur mine.	67°I0 35" / 35°38 30"	Aleurolites,clays,sandstones of "Upper part" of the Shabashek suite (Middle Jurassic)	4 beds with thickness from 0.78 up to I.55 m.Dipping - to NW, 30°.	Lustre variaties of mark "G" of low percentage of ash.	It is recommended for searching--prospecting works. (Searching square - I)
2.	Ia	-"-	67°I0 I4" / 35°37 57"	Aleurolites,clays,sandstones of the Regbulak suite (Low Jurassic)	2 beds with thickness of 2.25 and 0.35 m. Dipping - NW , 30°.	-"-	-"-
3.	2	"Lela-II".Lela sai in 5 km above by the sai from the Lela-I deposit.	67°08 I9" / 35°37 I0"	The same as for Lela-I.	9 beds with thickness from 0.20 up to 2.80 m.Dipping - NW, 50°.	-"-	-"-
4.	3	"Danitur"-in 30 km from city Darra-i-Suf,up-stream the river under the same name.	67°I7 34" / 35°42 20"	Aleurolites,densed clays, sandstones of the Regbulak suite (Low Jurassic)	2 beds of closed of complicated structure with thickness from 2.0 up to 3.5 m, dipping - SW , 30-20°.	Half-lustre ash coal of mark "G".	The deposit is going to be exploited.
5.	3a	In 4 km from the Danitur deposit along the Saritor river,in its right slope.	67°I9 48" / 35°4I 24"	-"-	2 closed beds of complicated structure with thickness from 3.60(upper) up to 3.20 (low).Azimuth of dipping--SW , 20-30°.	Apparently,beds are of the same stratygraphical level that at the Danitur deposit.	
6.	3b	In I.8 km to SSE from the Danitur deposit.	67°I7 57" / 35°4I 22"	Aleurolites,dense clays, sandstones of "upper" part of the Shabashek suite (Middle Jurassic).	Complicated bed with lenses of lustre coal up to 7 cm with total thickness up to I.5 m.Azimuth of dipping - 200, 25-30°.	Lustre hard coal	Of no practical importance
7.	3c	In 2.5 km to SE from the Danitur deposit	67°I8 32" / 35°4I II"	-"-	Complicated coal bed with total thickness of0.95 m. Thickness of hard coal -is 0.2I m.	Lustre,striped,in some interbeds is sooted.	-"-
8.	3	In 2.2 km to South from the Danitur deposit	67°I7 24" / 35°4I 03"	-"-	Complicatedcoal bed with total thickness of 0.79 m.Thickness of hard coal is o.II m.Azimuth of dipping 200° 25°.	-"-	-"-
9.	4	"Saritor" in 8 km above the Saritor river from the Danitur deposit at the right slope of the valley.	67°2I 20" / 35°38 23"	Aleurolites,dense clays and sandstones of the Regbulak suite (Low Jurassic).	2 closed beds with thickness of I.I0 m and 0.97 m.Dipping -NNE,angle-25-30°.	Half-lustre and dull coal of low ash mark "D".Apparently,at the same level that coals of the Danitur deposit.	They are worthy of more detailed searching--prospecting works.
I0.	5	"West Garmak"-in the Darra-i-Garmak,in 3.5 km to NE from the Danitur deposit	67°I8 28" / 35°44 00"	Aleurolites,dense clays,sandstones of the Shabashek suite (Middle Jurassic).	I0 coal beds with thickness from0.50 up to 8.30 m.The occurrence is complicated--folded.	Half-lustre and lustre low ash coals of mark "G".	-"-
II.	5a	The same place,in I km to SW from "West Garmak".	67°I7 48" / 35°43 I2"	-"-	In old openings were recovered coal beds with thickness of I.5m 2.5 m.	Apparently.it is the same as in point 5	They are worthy of more detailed searching--prospecting works

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I	2	3	4	5	6	7-8	9
I2	5b	"West Garmak" in the Darra-i-Garmak valley in I.5 km toNE from "West Garmak".	67°19 I0 " 35°44 27"	Aleurolites,dense clays,sandstones of the Shabashek suite (Middle Jurassic).	Old openings for coal,caved.	Apparently, the same as in point 5.	Are worthy of more detailed searching- prospecting works.
I3	5c	The same,in 2.6 km to NE from West Garmak".	67°20 06" 35°44'23"	-"-	-"-	-"-	-"-
I4.	6	"East Garmak" - in the "Garmak" valley,in 4.5 km to SW from Chal--Dukhtaran village.	67°2I 05" 35°43 40"	-"-	4 coal beds with thickness from 0.45 up to I.43 m.Dipping - to South ,angle 80-85°.	The same,as by coal beds of "West Garmak".	-"-
I5.	6a	"Darra-i-K "in 2.7 km to ESE from East Garmak.	67°22 48" 35°43 I3"	-"-	Several beds of coal with thickness of 0.I0 m and even more.	Were not investigated	Of no practical meaning.
I6.	6b	In I.4 km to ESE from "East Garmak".	67°2I 57" 35°43 26"	-"-	Six beds with thickness from 0.I5 up to 0.45 m.	-"-	May be represents interest in complex with "East Garmak".
I7.	7	"Karamkul" in 6 km to the West from the Shabashek deposit.	67°23 06" 35°4I 23"	Argillites,clays,sandstones of the Regbulak suite (Low Jurassic".	5 beds of hard coal with thickness from 0.68 up to 2.50 m. Dipping -to N with angle 40-60°.	Coals of mark "G" of different ashness.	It is recommended for searching-prospecting works.
I8.	7a	In 2 km to NW from Karamkul village in Changab sai.	67°22 04" 35°42 00"	-"-	2 beds of hard coal with thickness from 2.25 up to 4.6 m.	Were not investigated.	-"-
I9.	7b	In I km to East from Karamkul village.	67°23 48" 35°4I 26"	-"-	The same with thickness of 0.66 and uncleared thickness	-"-	Has no independent meaning.
20.	8	"Northern Darvaza" in 2.5 km to WSW from Shabashek deposit.	67°25 20" 35°4I 23"	Argillites,clays,sandstones of "Low part" of the Shabashek suite (Middle Jurassic".	I bed of hard coal with thickness of 0.95 m.Dipping to NNE with angle of 60-70°.	Coals of mark "G".	
2I.	8a	In I.2 km to NW from Darvaza village	67°24 42" 35°4I 42"	Argillites,clays,sandstones of"low part" of the Shabashek suite (Middle Jurassic").	The same with thickness of I.89 m. Dipping to South with angle 60°.	-"-	
22.	9	"Southern Darvaza" in I km to South from "Northern Darvaza" deposit.	67°25 08" 35°4I 07"	-"-	I bed of hard coal with thickness of 0.55 m.	-"-	
23.	I0	"Shabashek " -the uppers of the Chel-Dukhtaran river.	67°27 00" 35°4I 36"	Argillites,dense clays,sandstones of the Shabashek suite (middle Jurassic) and the Bashek suite (upper Jurassic).	I5 beds of hard coal with thickness from 0.50 up to 2.98 m.Thickness of working beds is more than Im -5. Coarse synclinal folding.	Coals of marks "G" and "D" of low ash.	Being exploited in I964. Summary reserves - - 79765 mln. tons.
24.	I0a	In I.2 km to SSW from the Shabashek deposit.	67°26 42" 35°40 57"	Argillites,sandstones of the Shabashek suite (Middle Jurassic).	I bed of hard coal with thickness of 2.0 m.	Were not investigated	

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I	2	3	4	5	6	7-8	9
25.	II	"Sarry-Assia" uppers of the Darra--i-Alma, in 0.5 km below Sary-Assia vil.	67°33 28" / 35°33 42"	Dense clays, aleurolites, sandstones, (Shabashek suite, Middle Jurassic).	I3 beds of hard coal with thickness from 0.5 to I2.87 m. They are dipping monoclinally to W with angle 37-75°.	Coals of mark "G", transitive to "Lfl." of low ash.	Had been exploited in 1965 Summary reserves 4.80 mln. tons.
26.	I2	"Sauzak-Kotal" pass, in 5.5 km to SSE from the Sary-Assia deposit.	67°35 I2" / 35°30 54"	-"-	3 beds of hard coal from i.5 to 3.0 m of complicated structure and lay in anticlinal wing.	Low and medial-ash coals of mark "G", intermediate into "Long flamed".	They are recommended for searching-prospecting works during the work at perspective square YII.
27.	I3	"Aukhurak" - in I0 km above by the river under the same name	67°4I 04" / 35°29 53"	Coaly clays, aleurolites, sandstones (middle Jurassic).	4 beds of hard coal with thickness from o.70 to 3.35 m. The dipping to NNE with angle from 20 to 80°, fine foldings.	Ash and high-ash hard coals of mark "Long flamed"	The same, as at the perspective square YIII.
28.	I4	In I km to NE from the Aukhurak coal manifestation (exp. 485)	67°4I 40" / 35°29 35"	Coaly clays, aleurolites, sandstones (Middle Jurassic)	Coal beds with thickness from 0.05 to 0.I0 m.	Were not investigated	They are of no practical importance.
29.	I5	Aukhurak valley, in 6 km above by the river from Shakhpasand village, right slope of the valley. (exp. 2839)	67°46 52" / 35°3I 04"	Fine interbeddings of dense clays, aleurolites, sandstones, (middle Jurassic)	Numerous interbeds of lustre coal with thickness from 0.05 up to 0.25 m. Steep foldings, overturned to the South.	Samples No. 2866-3, 2839-9 Ash coals (I8,6-I9.4%)	-"-
30.	I6	The same place, left slope of the valley (exp. 2866)	67°46 2I" / 35°3I I6"	-"-	Rare interbeds of lustre coal at the basement of section with thickness up to 0.I5 m. The dipping - to NW with angle of 20-25°.	-"-	-"-
3I.	I7	"Northern Rahfak", right slope to ESE from Doab-Shakhpasand village in 3.5 km (exp. 3I83).	67°57 02" / 35°32 06"	Argillites coaly, aleurolites, sandstones. Upper Triassic.	Interbeds of lustre coal among argillites with thickness up to 0.5 m.	Were not investigated	-"-
32	I8	"SouthernRahfak", left slope to SE from Doab-Shakhpasand village in 4.0 km (exp. 3I84)	67°50 52" / 35°3I 39"	Dense clays, aleurolites, sandstones. (Middle Jurassic)	2 interbeds of coal with thickness 0.I5 and 0.20 m among coaly clays.	-"-	-"-
33.	I9	"Western Garmak" uppers, in 2.2 km to WNW from Kara-Kutal pass (exp. 423-425).	67°47 04" / 35°29 05"	Aleurolites, dense clays, sandstones. Middle Jurassic.	I bed of coal with thickness 0.30 m. The dipping to NW with angles of 50-70°.	-"-	-"-
34.	20	Kara-Kutal, at N slope, near the pass (exp. 400)	67°45 44" / 35°28 47"	Interbedding of dense clays, aleurolites, sandstones. Middle Jurassic.	2 beds of soot coal with thickness I.20 and I.50 m. The dipping is to N and NW with angle of 20-30°.	-"-	They are of no practical importance, because of distribution limit (area -about 0.0I km).
35.	2I	"Kamard" right slope of the Kamard river in 3 km from Doab-Mekhzarin village (exp. 6406)	67°57 40" / 35°I5 25"	Interbedding of dense clays, aleurolites and sandstones. Low part of middle Jurassic.	I bed of complicated structure with thickness 0.45 m is traced at I000 m. Dipping -to NE with angle I5°.	-"-	Has no practical importance.
36.	22	"Northern Ishpushta" middle flow of the Surkhab river, in the Ishpushta valley, in 2.5 km.		-"-	5 beds of coal of complicated structure		In the process of exploration. Reserves are not counted yet.

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I	2	3	4	5	6	7-8	9
37.	23	"Southern Ishpushta,in 2.5 km to SW from the "Ishpushta"North" deposit (exp.)	68°05 29" / 35°I9 37"	-"-	I bed of coal with thickness 0.20-0.50m Geological conditions are the same,that at the"Northern Ishpushta"	Were not investigated	Had been explorated Reserves are miserable.
38.	24	"Barhfak" in 2.5 km to ENE from The "Northern Ishpushta" deposit (exp. 3I39)	68°07 I2" / 35°I9 55"	-"-	3 close beds of coal with thickness 0.I5, 0.20 and 0.35 m.Mode of occurrence is the same ,as at the "Northern Ishpushta"deposit.	-"-	Has no practical importance.
39.	25	" Angalak" middle flow of the Saigan river in 2I.0 km from the mouth at the left slope (exp. 3487)	67°43 00" / 35°II I9"	Interbedding of dense clays aleurolites,sandstones;"Low part" of Middle Jurassic.	In grey and black coaly clays numerous lenses and interbeds of soot coal with thickness of I to I5 cm	-"-	-"-
40.	26	"Mazar-Kul"-left tributary of the Saigan river,in 2.2 km from the sai mouth (exp. 6354)	67°53 32" / 35°I4 40"	-"-	The same,of lustre coal with thickness from I up to 6 cm.Dipping to NW with angle of 40°.	-"-	-"-
4I.	27	"Kar-Kar"-in I2 km to N from city Pul-i-Khumri	68°46 36" / 36°0I 57"	Aleurolites,dense clays,sandstones.At the contact of continental and sea sediments of the Callovian stage.Upper Jurassic.	I bed of coal with thickness from 0.60 up to 6.00 m. In average 3-4 m. The dipping is monoclinal to SW with angle of 30-35°.	Coal of mark "Long flamed", with ash.	Having been exploitated oriental reserves together with Dudkash deposit - -I2 mln. tons.
42	28	"Dudkash" in I.8 km to S from the "Kar-Kar" deposit (exp. 27SI9)	68°46 48" / 36°0I 00"	-"-	The same bed,that at the "Kar-Kar",but its thickness 0.9 m with swells up to 3, rare 5 m. The mode of occurrence is the same.	-"-	Having been exploitated Oriental reserves together with "Kar-Kar" deposit -I2 mln. tons.
43.	29	In 0.3 km to SSE from the "Dudkash" deposit,at the opposite side of the valley.	68°46 56" / 36°00 46"	The section is exposed badly	The continuation to S of the same bed, as at the "Dudkash", old openings caved and watered.	Were not investigated	
44.	30	"Western Dudkash" -in I.4 km to WSW from the "Dudkash" deposit (Exp. I3-I8)	68°45 57" / 36°00 43"	Interbedding of bands of dense clays,aleurolites and sandstones.Low Jurassic.	In the upper part of the section of the Low Jurassic there three coal-bearing ~~deposits~~ bands: low: in interval of I2.0 m contains 7 bands of coal with thickness from o.o8 up to 0.45 m. middle: in interval of II.30 m contains 5 bands of coal with thickness 0.I0-up to 0.35 m. upper:in interval of I4.45 m contains II bands of coal with thickness from 0.05 up to 0.50 m. Dipping to E with angle of 20-25°.	Ash coals of mark "Long flamed" and of mark "G".	They are recommended for searching-prospecting works,in connection with their close location to the Dudkash deposit.They represent interest also in connection with their low-Jurassic age.

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2	3	4	5	6	7-8	9
3I	"Eastern Salang"-uppers of Salang sai,in 8 km toENE from city Pul-i-Khumri (exp.59).	68°I6 30" / 35°59 I3"	Interbedding of dense clays,aleurolites,sa sandstones.Callovian stage,Upper Jurassic Section likes like the Dudkashian.	I coal bed with thickness of 0.90. The dipping of beds is to E with angle of 20°.		
32	"Western Salang"-in 0.6 km to W "Eastern Salang" at the left slope of the valley.	68°I6 04" / ———	Interbedding of dense clays,aleurolites and sandstones.Low Jurassic.	I coal bed of simple structure with thickness of 0.90 m and in I.3 m below- - 3 interbeds of ~~muiy~~ clayey coal with thickness of 0.I0-0.I5 m,divided by coaly clay of the same thickness.Dipping of beds to ENE with angle of 25°.		
33	"Chal-I"-at the left slope of the Tanga valley,in 3.8 km to SW from Chal village (exp.4595,I0706,II079)	69°29 20" / 36°30 II"	Interbedding of dense clays,aleurolites and sandstones.Middle Jurassic.	2 beds of coal with thickness of o.62 and 0.25 m.Beds are vertical,intensively crumpled.		
34	"Chal-II" in 0.5 km to S from "Chal-I" deposit in the right slope of the valley(exp.II080,9929,9930)	69°29 I8 / 69°29 54"	Interbedding of dark coaly clays,aleurolites and sandstones.Upper Jurassic.	2 beds of coal with thickness of 0.20 m and 0.57 m of complicated structure,occurrence is overturned.		
35	"Siakh-Darra-I"-in mouth ofthe same name sai in I km to E from "Chal-I" deposit (exp.III00).	69°29 52" / 36°30 03"	Interbedding of sandstones,aleurolites and dense clays.Upper Jurassic,the Callovian,band II.	A number of coal bands with thickness from 0.I6 up to 0.26 m with total thickness up to I.I3 m.Lays in overturned position with dipping to S with angle of 50°.	Ash coals of mark "C".	Independently they have no practical importance.
36	"Siakh-Darra-II" in 0.7 km from "Siakh-Darra-I,above the sai.(exp.II09I,II092, 9932,9933).	69°29 44" / 36°29 48"	Interbedding of dense clays,sometimes of coaly aleurolites,sandstones. Middle Jurassic.	4 beds of coal with thickness from 0.05 up to 0.035 m.The dipping -toSE with angle of 45°.		
37	"Darra-i-Kolon" in the same name sai,interflowing into the Chal river from the left in 2.6 km above by the river from place(exp.II065,II067,III60).	69°3I I0" / 36°30 00"	Interbedding of aleurolites,dense clays,sometimes coaly sandstones and tuffs broken by small intrusions.Low Jurassic.	3 beds of coal with thickness from 0.70 up to I.25 /pure coal/.Beds are of simple and complicated structure and have dipping toSE with angle of 60-70°.	Ash and low-ash coals of marks "C" and "E".	They are recommended for searching-prospecting works.
37a	By the left side of the Chal river in 0.30-0.40 km above the Darra-i-Kolon mouth sai(exp.III26)	69°3I 32" / 36°30 06"	———	I bed of coal of complicated structure with thickness up to I.25 (pure coal).	———	It has no independent practical importance.
38	"Kolta-Tau"-right slope of the Chal river near the bed in I.2 km above bridge. (exp. III23).	69°30 4I" / 36°30 22"				
39	"Zamburak-I" left slope of the valley near lower part of Zamburak village.(exp.II095, II096,9927,9928).	69° ~~34~~ 42" / 36° 3I 25"				
40	"Zamburak-2" in I km above by the valley from "Zamburak-I" coal manifestation. (exp. 8 by B.N.Androsov)	69°35 00" / 36°3I 00"				

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2	3	4	5	6	7-8	9
41	"Sang-i-Liashm-I" above by the Zamburak river from the Zamburak coal manifestation in 0.5 km (exp.II28I).	69°35 40" / 36°30 5I"	Interbedding of sandstones ,aleuvritic clays,aleurolites.Middle Jurassic.	I coal bed of simple structure with thickness of 0.23 m. The dipping to SE with angle of 30°.		Has no practical importance.
42	"Sang-i-Liashm-2" above by the Zamburak river from the"Sang-i--Liashm-I" in o.3 km (exp.II239).	69°36 I3" / 36°30 49"	Coaly dense clays,aleurolites among bazal sandstones of upper Jurassic (Callovian,band)	I coal bed of simple structure with thickness of 0.20 m.The dipping to SE with angle of 30°.		
42a	In 0.75 km to the east from coal manifestation"Sang-i-Liashm-2", against kishlak near river bank (II2I5)	69°36 44" / 36°30 49"	Interbedding of coaly clays,aleurolites, Upper Jurassic,Callovian,band I	In dump of fragments of coal up to 5 cm in crossing.		
43	"Sang-i-Liashm-3" valley of the sangiliashm river,right slope near river brink (exp. II2I8)	69°37 06" / 36°30 50"	Interbedding of dense clays and aleurolites -band of media of bazal sandstones of the upper Jurassic (Callovian,band I)	2 interbeds of coal: one has thickness of 0.I5-0.20 m, another 0.05m. Dipping of interbeds to NE with angle of 35°.		
44	"Chalai-Khurt-I" against Chalai-Khurt village in the left slope of the valley near river bed (exp. II226)	69°37 4I / 36°29 I0"	Interbedding of dense clays,aleurolites and sandstones.Upper part of the section of low-middle Jurassic.	Coal bed of complicated structure with thickness of 0.48, bands of pure coal from 0.02 up to 0.05.Total thickness is of 0.I6 m.		
45	"Chalai-Khurt-II" in 0.8 km above by the river from "Chalai-Khurt-I" coal manifestation in the right side of the valley. (exp. II227)	69°38 20" / 36°29 I0"		6 fine coal beds with thickness from 0.05 up to 0.30 m. They lay in NW wing of anticlinal with dipping to NW with angle of 50-60°.South-eastern wing is cut by fracture.		
46	"Bazarak" in 5 km from Bazarak village,in 5.5 km to SSE from Zamburak village. (exp. II67,9934,3 B.N.Androsov)	69°35 45" / 36°28 36"	Band of dense clays and aleurolites among sandstones of bazal band of (upper Jurassic,Callovian,band I).	6 coal beds with thickness from 0.34 up to I.95 m (pure coal).The mode of occurrence is complicated,folded.	Ash coals of mark "C".	Represents interest for more complicated search--prospecting works.

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		deposit (exp. II79I).		Conglomerates, of the Upper Jurassic (Callovian, band 2).	dipping is with angle of 40°.			
55	"Kasakton" -right slope of the Kashakton valley in 3 km above the mouth.	69°41 56" / 36°36 36"				Have not investigated		
47	"Saed-I" in 5.8 km to ESE from Zamburak village.(exp.II263).	69°33 [illegible]		Interbedding of aleurolitic clays, aleurolites,sandstones,conglomerates, Upper Jurassic (Callovian,bands 2-3).	I m coal interbed with thickness of 0.I5 m. The beds are dipping to NE with angle of 70°.			
56	"Farkhar"-left side of the Farkhar valley above the mouth of the Kashakton sai.	69°43 I6" / 36°37 5I"						
48	"Saed-2" in 9 km to ESE from Zamburak village (exp. II286)	69°40 I2" / 36°30 00"						
49	"Saed-3" in 8.5 km to SE from Zamburak village	69°39 52" / 36°29 03"						
50	"Zumgab" -in 2.5 km to SW from Zumgab village	69°42 I2" / 36°30 I3"						
5I	"Namakab-I" at the left slope of the Namakab valley in 7 km to S from the Tanga-Khana saline-coal deposit (exp. II355- II358)	69° 4I I6" / 36° 3I 04"		Interbedding of sandstones,aleurolites and dense clays. Upper Jurassic,Callovian,band 2-3 m.	I coal bed of complicated structure with thickness up to 3.90 m (pure coal) The beds are dipping to SE with angles from 30-55°.	Coal of low ash and ash of mark "C".		It is recommended for more detailed prospecting works.
52	"Namakab-2" in I km to SE from the "Namakab-I" deposit(exp.II353).	69°4I 40" / 36°30 47"			I coal bed of complicated structure with thickness of I.05 m (pure coal).The dipping - to SE with angle of I5°.			
53	"Roshal-I" in 3.5 km to ENE from the Namakab coal deposit (exp. II40I,II42I).	69°40 52" / 36°35 25"		Sandstones,dense clays,aleurolites of Upper Jurassic.(Callovian,low band 2).	3 complicated coal beds with thickness from I.0 up to 2.30 m (pure coal). They are crumpled into foldings and fractured.	Ash coals of mark "C-C"		-"-
54	"Roshal-2" in 2.5 km to NE from the deposit (exp. II79I).	69°4I 56" / 36°37 I0"		Conglomerates,sandstones,dense clays of the Upper Jurassic (Callovian, band 2).	I coal bed with thickness of 0.40 m. The dipping is with angle of 40°.	Have not investigated		
55	"Kasakton" -right slope of the Kashakton valley in 3 km above the mouth.	[illegible] / [illegible]		69°4I 56" / 36°36 36"				
56	"Farkhar"-left side of the Farkhar valley above the mouth of the Kashakton sai.	69°43 I6" / 36°37 5I"						
57	"Nakhrin" in 2 km to NE from city Nakhrin (exp. 3792)	69°09 48" / 36°02 23"		Interbedding of dense clays,aleurolites and sandstones,rare conglomerates. The low-middle Jurassic.	4 coal beds in the upper part of the section (band "e") with thickness of I.00,4.40,0.75 and 0.90.The rocks are crumpled,faulted by fractures.	Ash coals of mark "G"		Because of loq quality of coal,limited distribution and complicateness of tectonic conditions the deposit cannot be of considerable practical interest.
57a	Im 0.8 km to ESE from the Nakhtin deposit (exp. 3800-3803,4598,4599).	69°I0 I6" / 36°02 I6"			By trenches were discovered 5 coal beds with thickness of 3.20 , 3.20,I.0,0.30 and 0.30 m. in under tectonic complicated conditions.Apparently,these coals of the upper part of the section (band "e")			
57b	In I.5 km to ENE from the Nakhrin deposit.(exp. 4607)	69°I0 40" / 36°02 37"			3 beds of coal with thickness in the low part of the fracture (band"e") of 0.35, 0.35, and 0.45 m.			

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2	3	4	5	6	7-8	9
58	"Nalak" sai Nalak in4,5 km from the mouth Surhob river bed , on the right slope of the sai. (exp.5080)	68° I 68° I0 40" 35° 24 02"	Interbedding of clays, aleurolites and samdstones of the lower part" of middle jurassic.	Among coaly clays are beds of hard coal with thicnesso of 0,5_0,26 m. (5 beds all in all). The coal bed of complex structure with thicness of I,4m. Coaly clays are predominated. Coal forms up to beds with thicness up to 0,06 m. The interval is 23 m.	Not investigated.	Of no practical importance.
58a	To "Nalak" show , in I,4 km. to the west. (exp. 5087)	68° 09 48" 35° 24 04"		The coal bed of complex structure with thicness of I,4m. Coaly clays are predominated. Coal forms up to 4 beds with thicness up to 0,06 m.		
58b	In 2,2 km tom WSW from the show " Nalak". (exp.5090_5092).	68° 09 I2" 35° 23 47"	Occurs just on the weathering erust	Heavy coaly clays with thicness of up to 5-6 m. With lens of glittering coal. The quantity-3-4. THEthicness -upto 0,06m.		
58c	In 3,2km to WSW from "Nalak" show. (exp. 5I09).	68° 08 34" 35° 24 00"		Black heavy coaly clays with thicness of up to2m , with lens of semi-shining hard coal with thicness up to 0,04m.		
59	Interstream area between the valleys of the rivers Nalak & Amir-Amad. (Istoma).(exp.5I37).	68° 09 42" 35° 25 24"		Black coaly clays & aleurolites with thicnessm up to I5m. Upperwards- a bed of heavy coaly clays with bands of hard coal with thicness from 0,05 up to 0,I5m. The dipping to NW with anglesup to I0°. The thicness of coaly clays reduces to 5-6m.		
59a	In I,Ikm to SW from the preceeding point (59). (exp.5I36).	68° 09 28" 35° 25 03"				
60	"Amir- Amand" .Upper valley of Iston sai. (exp.8222).	68° 09 28" 35° 26 23"	Interbedding of sandstones, conglomerates, dense clays, coaly clays. " Lower part" of middle Jurassic.	I bed of hard coal ofcomplex structure with thicness of 2,0m. Pure coal-with thicness of I, 70m,. THe dipping to N with angles of 60°. From N & W cutted by thrust.		

COPPER

2	3	4	5	6	7 MINERALOGICAL COMPOSITION	8 CONTENT OF MINERALS IN %	9
6I	Undercurrentof Zard-Sanch river	67°58 32" 35°II 05"	Granodiorites		Copper illinitions on fissures		Of no practical importance.
62	The valley of the river Saigan.	67°I 4I2" 35° I0 02"	Siliceous rocks			Chrysocolla illinations Cu-0,3 Ag-0,00I	Of no practical importance.
63	The valley of the river Kala-i-Murat	68° 23 5I" 35°46 42"	Quartzous porphyrys	Vein of I-2 sm. thickness Dipping - I80°	Opal,malachite illinations, incrustations.		Of no practical importance.
64	Chinorak creek	69° II I4" 36° 02 22"	Plasho-granite& granodiorite contact	Fine impregnation, lens with sulphide impregnation (2m. for I0sm.) Orientated along fissures.	Chalcopyrite, copper hydroxides,.	Cu-0,3 Ag-0,0003 Zn-0,0I Sn-0,03	——"——"——2"

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2	3	4	5	6	7	8	9
65	Upper valley of Shindar river POLYMETALS	69° II I6" 35° 59 54"	Plasho- granite & granodiorite contact	Sulphide impregnation		Cu-0,3 Ag-0,003	Of no practical importance.
66	To NE From Kara- Kotal pass	67° 48 57" 35° 28 40"	Silicification Zone in diabases & their tuffs	Lens (length-about Im. Thickness- IOsm.)	Pyrite, galenite impregnation, limonitisation.	Cu-0,03 Ag-traces Zn-0,03 Pb-0,003	" "
67	Left side of Ishpushta river Itangi-Ishpushta ore show.	68° 05 46" 35° 2I 50	Limestones. The Upper Cretaceous.	The zone of jointing.	Impregnation of dull ores, chrysocolla illinations.	Cu-up to 0,I Ag-up to 0,003 Pb-0,03 Sn-up to 0,I	
68	Left side of Surhob river.	68° II 25" 35° 24 I4"	Limestone & granodiorite contact.	Scarn bodies of irregular shape with thickness up to 20 m., lens of scarn (I5m. for 6m.)	Impregnation & concretion of chalcopyrite, pyrite, magnetite.		
69	Copper ore show "Ishpushta", right side of Ishpushta river.	68°04 25" 35°I8 32"	Interbeddings of conglomerates, sandstones, aleurolites, argillites.	Bedlike deposition, almost comformable with containing rocks. By dipping traced for200m.. Thickness-300m.	Impregnation of chalcopyrite, chrysocolla illinations	Cu- up to 3% Pg-upto 0,0I Ag-up to 0,60I Zn-up to0,I	
70, 71	Left side of Ishpushta river	68o 05 I3" 35° I8 24" 68°06 32" 35° I8 37"	Acid effusions, tuff-sandstones, conglomerates	Zone of splitting with thickness of about 0,5m. By strike-320° . Traced for 30m.	Chalcopyrite, malachite, lazurite, sphalerite.	Cu-0,3 Zn-0,I Sn-0,0I Ag-traces Pg,Cd,Mo- traces	
72	Near the mouth of the river Ishpushta, at it's fall into the river Surhob.	68° 05 26" 35° I8 05"	Sandstones, argillites (T3)	Zone of splitting. Thickness up to 3 m. Length-about 35m. Azimuth of dipping -340° Angle less 35°.	Azurites, malachites, Chalkopyrite, pyrite	Cu-I Ag,Cu,Zn-0.0I	
72a	Right side of the Surkhab river above the Ishpushta power plant	68°05 02" 35°I7 58"	Metamorphic schists	Quartz veinlet of 3-7 cm, Azimuth of dipping 325° Angle less 70°.	Chalkopyrite copper green	Cu- 3 Su-0.I Ag-0.0I Mo-0.03	
73	Left side of the Surkhab river, near Ishpushta village	68°05 36" 35°I8 00"	Fillite-like schists injected by quartz	Quartz veinlets with thickness of 7 cm. Azimuth of dipping 50° Angle is less 70°, 230° less 80°.	Secondary minerals of Copper in quartz and enclosing it rocks	Cu-I Pg-0.0I Ag,Cu,Bi-0.0I Zn-0.03	
74	The top of the Kau-Shandos sai	68°o6 06" 35°I8 50"	Aleurolites, sandstones	Crushing zone with thickness about 40 m	Rocks are ochresised, copper green, chalkopyrite impregnation	Cu-0.0I Pg-0.003 Zn-0.0I	
75	Left side of the Surkhab river near Ishpushta village	68°06 20" 35°I8 29"	Sandstones and argillites	Quartz veinlet	Chalkopyrite impregnation	Cu-0.0I Pb-0.I Ag-0.003	
			Contact of quartz-cericite schists with sandstones, argillites, conglomerates	scarned areas of lenses-like form	Chalkopyrite impregnation	Cu-0.3, Bi- 0.0I Zn-0.I Su-0.003	Ag- 0.00I
76	Right side of the Surkhab river below the Ishpushta mouth	68°06 36" 35°I8 25"					

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2	3	4	5	6	7	8	9
77	Left side of the Surkhab river near Darra-i-Ala Sang village	68°06 48" 35°18 49	Sandstones,argillites,quartz--cericite schists	Scarnoid bodies of incorrect form up to I50 m by strike and up to I25 m of thickness	Magnetite,titanomagnetite, chalkopyrite,galenite,sphalerite,selvage of aerugo	Cu- 3 Zn-0.0I	
78	Left side of the Surkhab river below the Ishpushta mouth	68°07 I6" 35°I8 59	Contact of granodiorites and marbles	Scarnoid bodies of incorrect lenses-like form,"iron hat".	Fine chalkopyrite ,pyrite, jarositeimpregnations,illinition of aerugo	Cu-up 3;Pg-0.3 Zn-I; Ag-0.003 Cd-0.03; Sn-0.0I	
79	Right side of the Surkhab river opposite the Ishpushta mouth	68°o5 34" 35°I7 40"	Contact of marbleised limestones with quartz-cericite schists	Bodies of elongated incorrect form with maximum thickness of	Pyrrotine,chalkopyrite, galenite in the form of nests and fine impregnation.	Cu-0.3; Pg-o.oI Ag-0.00I;Zn-0.I Sn-0.0I	
80	Bidak creek	69°06 32" 35°58 I6	Gabbro	Quartz veins with thickness up to 0.5 m	hematite,chalkopyrite, selvage of aerugo	Cu-I;Pg-0.3;Zn-I	
8I	The Naryn river,left side near Khodja-Khizir village	69°07 02" 35°58 36"	Tuffs	Silicificated ferruginizated rocks with fine impregnation of sulphides	Pyrite,halenite	Pg-0.I;Cu-0.0I Ag-traces;Zn-0.I	
82	Uppers of the Bodo-i-Darra in 5 km to North-West from Samandau village	69°30 3I" 36°27 53	Garnetisised tuff-schists	Zones of silicification with thickness up to 0.2 m	Halenite	Pg-5.7I Zn-6.90	

A L U M I N I U M

83	Uppers of the Nalak creek	68°09 20" 35°25 I6"	Effusives of basic composition, weathering crust	Mantle-like deposit of incorrect contours with thickness up to I5 m	Bauxite	See description in text	

R A R E M E T A L S

84	Tundara creek up the stream from Arbob-Murat village	68°22 I8" 35°4I 20"	Plate-like granites	definition	Molybdenite,fluorite,tantal--niobium minerals,hematite, pyrite	Mo-0.3;Nb-0.03;Sn-0.003 La-0.03	
85	Tundara creek	68°22 06" 35°40 34"	Aplite-like granites	Impregnation	Molibdenite, fluorite, pyrite.	Mo-0,00I; Nb-0,0I La-0,06; T- 0,0I	
86	Left side of Ishpushta river	68° 05 28" 35° I7 33"	Effusions of acid composition	Zone of splitting. Thickness about 0,5m. By strike traced for 30m.	Sphalerite, halenite, molibdenite, chalkopyrite, malachite,	Mo-0,0I Cu-0,3 Zn-0,I	No practikal importance.
87	Left side of Ishpushta river up from Ishpushta power station	*68°06 57" 35° I8 57"	Metamorphic slates	Vein of 3-7sm. thicness.	Fine impregnation chalkopyrite, molybdenite, illinations of chrysocolla	Mo-0,03 Cu-3,0	" "

C E L E S T I N E S U L P H U R

88, 89	Near the vilage Dasht-i-Safit (upper valley of Sarı-Kucha creek) ,of the left tributary of Kamerad river/.	67°57 24" 35° I8 32" 67° 59 08" 35°I9 4I"	Marls, gypsums	Beblike deposit ofI-I,5m. thicness	Selestine, barite,natural sulphur,gypsum.		more detailed investigation is recommended

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2	3	4	5	6	7	8	9
90	Near the village Tangi- Murach (I,5 km.)	69°I2 24" / 36°I7 I3"	Clays, marls	Bedlike dppositions of lens	Selestine	~~Sr~~ $SrSO_4$ up to 76%	Exploration-prospecting has been done, TOapply the reports on the exploration-prospectingworks on Tanchi-Mura deposit donex in I96
	ROCK SALT						
9I	Rock salt show "Chali-I" in 2 km. to N W of the village Chal	69° 3I 00" / 36°3I 56"	Gypsum, clays, aleurolites	Salt cupola. Height no less 400m., traced by the side for I km.	Interbedding of galenites with brown clays & gypsum	NaCl- 84%	
92	Rock salt show Chali"-2 in 2,5 km. to the north of the village Chali	69°32 08" / 36° 32 48"	Clays, gypsum	Salt cupola,the heightno less than I5m.	Rock sal t with veins of clay	NaCl-83%	
93	Rock salt show "Namakab" in 2km. to the SW of the village Sari-Kan Right side of Namakab ~~a~~ river	69°38 56" / 36°35 0,2"	Clays, gypsum		Rock salt with veins of clay	NaCl-~~84~~%	
	LIMESTONES						
94	Left side of the river Surhob (Kunduz) near the town Puli-Khumri (concretex producing plant)	68°~~38~~ 56" / 35° 58 24"	Limestones, mafls	A bed of about 500m. thickness	Limestones, white, rosy, argentite, cream- coloured & & heavy bedded,finely- chrystalline	No analysis	Under explotation
95	Dudkash creek	68°46 00" / 36°00 40"	Clays , aleurolites, limestones.	A bed of about 30m. thickness	Grey, thick aphanitic,beddedx limestones	For composition to apply the text	Worth for producing ofx concrete with spotting additions
	DOLOMITES						
96	To the Kamperak pass ,by the way from the village Shenivogur	68°33 0,2" / 35°43 47"	Dolomites, argillites	A bed of thicness no less than 80m. By strike traced for about Im. Overlapped by loesses.	Dolomites, black, thick, massive	No analysis	
97	Dudkush creek	68° 47 20" / 36° 43 47"	Interbedding of argillites, aleurolites, dolomites, limestones , gypsum.	A bed of 3,9m. thickness	Bright-grey dolomite with greenish shade with gypsum concretion		
	MARL						
98	Left side of Sivak creek	67°53 42" / 35° I9 00"	Interbedding ofgypsum, marls	Beds ofthickness up to 40 m.	Porous, loose, fine-bedded, grey, rosy marls	TO apply the text.	
	ASBESTOS						
99	The left side Said-i-Kaion creek	68° 2I 20" / 35° 37 30"	Ultrabasic rocks	Beds of thicness up to I m.	Amphibole-asbestos	To apply the text.	No practical importance

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2	3	4	5	6	7	8	9
	T A L C						
I00	Uppercurrent of Danaguri creek	68°I8 56" / 35°43 55"	Ultrabasic rocks	The bodies of m isometric for ms	Talc is developed by ultrabasic rocks		No practical importance
	Clays						
I0I	The district of Dan-i- Tur village	67°I5 4I" / 35°43 I3"	Clays, sandstones, argillites	A bed of 30-50m, thickness	Claysof bluish- green colour		Clays infusible Brick production
I02	At the village Karam- kul	67°23 24" / 35°4I33"	Clays, coal	A bed of I m. thickness			Clays are infusible and can be used for brick production
I03	At the coal deposit " Shabashak" Ditch No 3 Between the 6th & 7Th beds of coal	67°23 24" / 35o 4I 45"	Aleurolites, sandstones, clays, coals.	Beds of thickness about 6m.			
I04	Nalak creek the left tributary of Surkhab river (exp. 5I36)	68°0,9 26" / 35° 25 27"	Diorite porphyry weathering crust	Bedlike beposit ofa about I3m. thickness	Grey foliated clays , sometimes with hydroxides of oolits of iron		Clays are infusible and fireproof
I05	Nalak creek (exp. 5080)	68°I0 29" / 35° 23 58"	Effusion crust weathering of average composition	A bedlike deposit ofabout 6m. thickness			Clays are infusible for brick productio A part of them probably fireproof
I06		68°46 20" / 36° 00 47"					
I07	Shabashek	67° 27 5I" / 35° 42 50"	Clays, coals, aleyrolites, argillites	A bed of about I0m. thickness			Were used for preparation Of brown solutions
II7	The median current of Kaukpar-Nachrin	68°52 36" / 35° 42 50"	Clays, sandstones, conglomerates	Beds of it thickness II-I7m.	Clays of brick- red colour, cloddish, weakly contaminated by gypsum & by sandstones	To apply the text	Can be used for preparation of xxxxxxxx borehole solutions
II8	The upper curent of Rafak sai	67° 5I 09" / 35° 3I 49"	Clays, aleurolites, coal	A bed of 5m. thickness	Grey-greenish, bedded clays	To apply the text	Can be used for preparation of borehole solutions
II9	The upper current of Nalak creek (exp.5080)	68°I0 29" / 35° 23 58"	Clays, sandstnes, conglomerates, coals.	Beds of thickness 3-4m.	Bright-grey,fat clays, aleurolited, elastic	To apply the text	Infusible, can be used for fireproof brick production, for preparation of borehole solutions
72	The left side of Surkhob river at Puli- Humri town, near the concrete-producing plant, at the road to it the village Dakhanitor	68° 40 32" / 35° 58 25"	Clays	A bed	Red-brown, bedded clays		Used as correcting additions in concrete production
	G Y P S U M						
I09	The upper current of Madr river	67° 26 25" / 35° 26 25"	Dolomites, limestones, clays	A bed of I2 m. thickness	Gypsum white, bedded	$CaSO_4 \cdot 2H_2O$-89,04	No pra ctical ip-tance.

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2	3	4	5	6	7	8	9
I0	Dashti-Safit area	67° 53 08" / 35° I7 0,9"	Clays, dolomitised limestones, gypsum, argillites	Beds of thickness up to 30m.	Gypsum of white, grey, seldom -yellowish colour, Sometimes half-transparent		
I1	The valley of the river Kamerad	67° 54 00" / 35° I8 32"	Clays, dolomites, gypsum	A set of beds of total thickness about 20m.	Gypsum of white, grey, seldom -yellowish, sometimes half-transparent .		A more detailed investigation is recommended.
I2	The valley of the river Nalak	68° I2 30" / 35° 24 06"	Clays, sandstones, gypsum	A set of beds of thickness about I2 m.			No practical importance
I3	Dudkash creek	68° 47 30" / 36° 00 55"	Clays, aleurolites, sandstones, dolomites	A set of beds of total thickness 50 m. By strike traced for I2m.	Grey, yellowish coloured gypsum, thick,.	Tp apply the text	A more detailed investigation is recommended
I4	Shupau creek, the left tributary of Tangi river	69° 08 56" / 36° 03 45"	Sandstones, gritstone, gypsum, clays	A set of beds ofup to Im. thickness	White, rosy, greenish-grey, loose gypsum	$CaSO_4 \cdot 2H_2O$-99,45	Exploited by local population. A more detailed investigation is recommended
I5	The left side of Namak-ab river in 2 km. to the south from the village Sari-Kan	69° 39 I4" / 36° 34 47"	Clays, Gypsum	A set of beds of about I50m.		Not investigated	A more detailed investigation is recommended
I6	In 2 km.toNW from the village Chal. Rock salt show" Chal-I"	69° 32 I4" / 36° 33 03"	Clays, gypsum, aleurolites	Beds of thickness up to some metres.	Gypsum is interbedded with clays, highly contaminated	Not investigated	No practical importance.
I20		67° 36 08" / 35° 30 32"					
I20a		67° 30 02" / 35° 3I 32"					

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