
A Journey to the Western Portion of the Celestial Range (Thian-Shan), or "Tsun-Lin" of the Ancient Chinese, from the Western Limits of the Trans-Ili Region to Tashkend

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On the 6th July I returned to Yeddo, and my companions to Yokohama.*

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XIII.—*A Journey to the Western portion of the Celestial Range (Thian-Shan), or "Tsun-Lin" of the Ancient Chinese, from the Western Limits of the Trans-Ili region to Tashkend.* By N. SEVERTSOFF. Translated from the Journal of the Russian Imperial Geographical Society, 1867, by ROBT. MICHELL, F.R.G.S.

THE earliest description of the Central Asian Uplands, the northern part of which, between the Chu and Syr-Daria, I surveyed in the year 1864, is to be found in the writings of the Buddhist monk Huen-Tszan, who journeyed through the whole of this region more than a thousand years ago (from 629 to 645 A.D.). I quote him here, because it is difficult to convey in a

* In the original Report of Mr. Adams a detailed account of the mulberry-tree and silkworm follows the above sketch of his journey.—[ED.]

few words a more accurate idea of the district:—"After proceeding from that country (the kingdom of Hogo) to the eastward, one enters the Tsun-lin Mountains. They are situated in the centre of Djambudvip; on the south they abut on a large snowy range; on the north they extend to the Warm Sea (Lake Issyk-kul; on the west they reach the kingdom of Hogo; on the east that of U-sha. From east to west, and from north to south, these mountains stretch over several thousand "li." Among them there are several steep summits. The valleys are gloomy, and full of precipices; masses of ice and snow are to be found in them at all seasons of the year; severe cold is experienced, and a strong wind prevails. Many onions (Tsun) grow in this country; hence the mountains are called 'Tsun-lin.' They are likewise so called, because the summits of the mountains are bluish; the word 'Tsun' in Chinese meaning also *blue*."

According to these boundaries of the Tsun-lin Mountains, it would appear that I visited the northern portion of this rugged region, between the Syr-Daria, and a line extending from Lake Issyk-kul to Mynbulak, or, more correctly, the northern boundary of the Tsun-lin.

Let us now examine the signification of the above description, which is in complete accordance with what I saw on the spot.

The Chinese traveller speaks of a mountainous region several hundred versts in length and breadth, in which are distributed several hundred peaks, not the slightest mention being made of mountain ranges. The valleys are deep, and the dark fissures are consequently clefts in a massive upheaved plateau, which is thickly dotted with peaks. Lastly, hollows with masses of ice and snow are spoken of; such is the depression of Rian-kul, situated to the northward of the sources of the Kashgar-Daria. The presence of snow in the hollows indicates the great height of the general upheaval, which is therefore, not without reason, called by the Orientals "the roof of the world."

In the northern part of the Tsun-lin surveyed by me, between the Chu and Talas, at the Arys and Upper Chirchik, mountain-ranges do apparently exist, as is indicated by the broader river-valleys which separate them. But a careful examination of their geology shows that these ranges are almost entirely an optical delusion, as they merge into the general plateau.

When this convex plateau was, at a distant geological period, an island in the middle of the sea, it must then have presented towards the north-west and west four narrow and deeply-indented inlets. These are the present valleys of the Talas, between the confluence of its upper waters and its passage through Cha-archa

Mountain, of the Ferghanah, following the course of the Syr-Daria, between Andijan and Khodjend; of the Zeravshan at Samarkand and higher up to Varsaminar; and that of Badakshan at the sources of the Oxus, or Amu-Daria.

These are the hollows that indent the Tsun-lin mountain-rise;* but I shall first describe its northern part, as I saw it in the order of my itinerary from Fort Vernoe to the south-west.

I shall consequently not describe what I saw in the steppe of the Siberian Kirghizes, and in the Alatau district. The ranges there, as far as I could observe them on my rather rapid journey through the country, will be mentioned in the proper place for the comparison of their characteristics. I will commence at once with Fort Kastek, from whence I started on the 5th (17th) May, 1864, with the detachment of General Cherniayef.

Kastek, as is well known, is situated at the northern base of the Trans-Ili-Alatau (Kungi-Alatau), as is Vernoe (Almaty), 80 versts ($53\frac{1}{2}$ miles) westward of the latter town, in $43^{\circ} 8' N.$ lat., and $93^{\circ} 41' 36'' E.$ long. of Ferro.

According to the measurement of Captain Golulef, the absolute height of Kastek is 3300 feet; consequently 1070 feet above Vernoe. It stands on a sloping descent, of a steppe character from the mountains towards the Ili.

From Kastek I proceeded direct to the south, along the river of the same name. The point of issue of this rivulet out of the mountain defile occurs 12 versts to the southward of the fort. The chain of the Trans-Ili-Alatau has here no hilly promontory, as at Almaty; but this is replaced by an evenly sloping declivity, ascending from the River Ili to an elevation of nearly 4000 feet, as at Almaty. The ground, however, between the fort and the hills, though rather undulating, preserves the general appearance of a steppe, as the hillocks slope gently.

The transition from steppe to mountain vegetation is very sudden. The gorge opens into the mountains in the form of a deep and narrow crevice in the rocks, to which bushes occasionally cling. At the bottom of this fissure the Kastek rushes with great noise and rapidity, leaping over enormous loose rocks, and overturning those of smaller size, in the manner of all mountain torrents. The road in some places is not more

* This is the only general designation which appears to me to be correct; there are spots in the mountain district that receive distinct appellations, but no common name exists for the whole elevation. This mountain-rise is formed by the conjunction of two enormous ranges, the Thian-Shan and Himalayan. A separate Bolor, as a mountain system, does not exist. This is the name of a river and town, which European geographers have applied to the north-western part of the Himalayas. The mountains visited by me belong to the western Thian-Shan, but present in some parts the Himalayan extension of strata—north-west to south-east.

than 2 fathoms broad between the river and the sides of the gorge, and even then it is artificially widened, and constantly crosses from side to side. The rocks consist at first of hard limestone; their sombre colour adds to the gloomy character of the defile, which was still further increased, on the occasion of my first visit, by the summits of the mountains being hidden by rain-clouds lowly suspended. After a distance of about 3 versts the limestone is succeeded by crystalline formations, principally of granite of the most typical character, with large crystals of rose-coloured felspar, and smaller ones of quartz and mica; this is alternated on the northern side of the range by syenite and diorite. Without, however, any sharp divisions between either of the formations, higher up on the right bank dark limestone, and on the left granite, are the predominant formations. The summit of the pass consists of vertical strata of mica-schist, which on the southern slope are again succeeded by granite and porphyritic syenite. The granite below the southern slope changes to limestone, upheaved at an angle of about 60° . At the very base of the mountains the prevalent formation is again granite. The limestone thrown up by that rock dips towards the N. 65° E., as also does the limestone on the northern slope of the range. It does not present any traces of metamorphic action, but retains the same character at its point of contact with the granite, as it exhibits at a distance of 600 feet from it, that is to say, it is not crystalline. The interspersions of compound granitic minerals in the limestone at the point of junction of the strata, is only observable for a thickness of 3 or 4 inches. I noticed this also in the other chains of the western Thian-Shan system, as will be described further on.

The southern slopes of the chain are much more abrupt than the northern; the vegetation is scantier, except in the deepest hollows with rivulets running through them. The yellow tulips of the northern slope are superseded on the southern by those of a red, orange, and red streaked with yellow* colours; and they are, moreover, distinguished by a more marked colouring. Generally speaking, there is less verdure, but a greater variety of flowers, than on the northern slope.

On both the slopes the tulip ranges to the height of about 7000 feet. On the northern, however, as one ascends, the stems become shorter and the flowers smaller, while on the southern, although the stem decreases in height, the flowers remain large to the extreme limit of the line of growth. At the summit

* On both slopes I found variations of one and the same species of tulip ("djantykh"), together with every conceivable transition of form.

of the pass, at a height of 7500 feet, Alpine plants begin to appear.*

Another difference between the two slopes is, that the southern are less abrupt than the northern. In the former, ravines occur more frequently, and are drier and less rocky; and the lateral ravines intersect the slopes at more acute angles. Altogether, the southern slopes are less picturesque than the northern, and the vegetation upon them partakes more of the steppe character.

But on the northern slopes also the "tchi" (*Aira sp.*), a plant most characteristic of the Kirghiz steppe,† is found in the mountains, at the widening of the valley of the Kastek, at an elevation of 4300 feet. This widening commences about 5 versts from the northern base of the range, and continues for about 7 versts. The Kastek flows along the whole of this distance under the right rocky edge of the valley; while along the left bank, between the river and the granite crags, extends an undulating plain, from 200 to 300 fathoms in breadth, intersected by several rivulets, which run down from the escarped summits of the Sùok-tiubé into the Kastek. A series of eminences, in the form of steep and towering mounds of about 200 feet in height, extend here, running parallel to the Kastek. Opposite the issues of the transverse valleys which descend from the Sùok-tiubé, they are intersected by other ridges of similar form, but which extend in a direction perpendicular to the River Kastek.

All these mounds appear to me to be the moraines of ancient glaciers. They consist of blocks of granite, syenite, and diorite, of various sizes, many of them large; some are more or less rounded, and some have sharp edges.‡ The spaces between the boulders in these ancient moraines are filled with unstratified clay.

These were the first traces of moraines I observed in Central Asia. Fortunately they were very plain, and must have remained almost unchanged since the melting of the glaciers by which they were formed. They led me to identify as remains of similar moraines, which have subsequently been washed away, the numerous dispersed boulders I had previously seen in the neighbourhood of Almaty, but not lower down to-

* The plants are collected, but not yet classified, as I was obliged to leave my herbarium at Chemkend.

† Where, however, it serves to indicate the dry spots of fluvial valleys, and hollows with water at a small depth under ground.

‡ Many at their summits are worn by the wind, and are covered with a thin coating of "kaoline"—porcelain clay—produced by the action of the wind on the felspar of the granite and syenite.

wards the River Ili. It was the moraines of the Kastek that led me to seek for traces of the glacial period in the mountain ranges between the Chu and the Syr-Daria; and not in vain, for after having attentively studied the Kastek moraines, I was afterwards able to detect at first sight even less visible traces of ancient glaciers.

The view which presents itself to the sight from the summit of the pass, powerfully impresses the beholder with its desert grandeur. On the left, one mountain-mass rises up after another, each steeper and more rugged than the last, towards the Talgar, the highest summit of the Trans-Ili-Alatau, where two lines of ridges, running parallel with the principal range, become discernible; and it is evident to the eye that the southern ridge, split across by the Buam defile, through which flows the Chu, extends also in a westerly direction under the name of the Kirghiznin-Alatau (Alexandrofsky range). The valleys of both the Kebins, Great and Little, are also visible from this point. On the right the Chu, often forming a silvery network of branches, disappears in the boundless steppe; directly in front rises a gigantic wall of rock (the Kirghiznin-Alatau), tinged with blue by the mist. The mountain seemed to rest on a mass of dark clouds that had descended into its gorges. The summits of the Thian-Shan to the south of the Kutemaldy, which Mr. Veniukof saw from the Kara-Kupus Pass, were at this time, 8th (20th) May, hidden by clouds hanging at about the elevation of the Buam defile. All the innumerable mountains on this horizon of more than 200 versts are rocky and bare; and only at the Kebin, and in the Buam defile, is a narrow dark-green fringe of pine to be seen.

From the same range, though more to the westward, and nearer to Süok-tiubé, Mr. Semenov, while proceeding to the Buam Pass in 1858, gazed on the valley of the Chu, and on the mountains of Kokand, as on coveted but forbidden fruit. In 1864 I also beheld these districts, but under more favourable circumstances. I took scientific possession of these long mysterious mountain-chains of Central Asia, and I felt rejoiced that it had fallen to my lot to continue the researches of the first scientific European who had visited the Thian-Shan.*

More eagerly still did I look toward the Kirghiznin-Alatau, with which my investigations were to commence; but for a whole week this enigmatical chain obstinately hid its head in clouds,

* Mr. Semenov, in 1867, descending from the mountain pass into the valley of the Chu, crossed this river at a point above the former Kokandian fort of Tokmak, and turned towards the south-east, proceeding up its course, and through the Buam defile, emerging at the foot of the Thian-Shan, at the western extremity of Issyk-kul.

increasing my impatience and intensifying my curiosity to a considerable degree. These dark clouds, rolling capriciously around the vast mountain-masses, metaphorically represented that impenetrable veil that had hitherto screened Central Asia from European investigation, and which had been so enticingly, though so partially, drawn aside in works of which Humboldt and Ritter availed themselves.

During this week I first became acquainted with the Sultu and Sary-bagysh tribes. They appeared to me to be less dirty than Messrs. Veniukof and Valikhanof describe them. To the accounts of these gentlemen I, who am but a poor ethnographer, have nothing to add, save perhaps that the formal visits of their "Manaps," or tribe-elders, to our camp were always accompanied by flute-playing and other music. The topography of their tribal encampments is but little known, and to this I intend, during my approaching second journey to the same region, to direct particular attention. The shape of their skulls is of the general Kirghiz character, being somewhat gable-shaped, towering towards the crown. Their features differ less than those of the Kirghiz-kasiaks; their faces are broad, angular, flat-nosed, and narrow-eyed, with high cheek-bones and scrubby beards.*

At last, on the 16th (28th) May, the curtain of clouds was drawn off from the Kirghiznin-Alataù, and its jagged snow-clad summits glistened in the clear blue sky. I proceeded towards them through the valley of the Issyk-kul, finding at the base of the range strata of red argillaceous sandstone, which afterwards merges into conglomerate. These strata extend w. 29° N., and their dip is 50° to 52° , not from the axis of the range, but towards it.

This proves the connexion of the ranges on both banks of the Chu. The sandstone strata at the base of the southern range are raised up by granite, which is denuded at the base of the northern range. The sandstone strata extend for about 2 versts beyond; the sides of the valley of Issyk-kul, to the height of several hundred feet, consist of unstratified clay, intermixed with boulders, and are frequently abrupt and precipitous; all the gentle slopes, as well as the narrow bottom of the valley, being covered with a luxuriant vegetation of various grasses and shrubs, which were then, in the middle of May, (O. S.), mostly in bloom. A blue unbroken carpet of "forget-me-nots" covered the slopes of the outlying hills of the Kirghiznin-Alataù. The

* In the Kirghiz features the skull and lower jaw are of almost equal breadth, so that the face is as nearly as possible square; the arch of the skull (*Aræus zygomatæus*) does not protrude much beyond the temples. In Kalmuck faces this arch is very curved, so that the face is rhomboidal in shape.

bushes commence at a height of about 4000 feet; 15 versts higher up the valley, at an elevation of about 5350 feet, the pine (*Picea Schrenkiana*) begins to grow. At this point we were obliged to return; and on the following day, crossing the spot where the granite is denuded, we entered the longitudinal valley extending between the outlying spurs and the main range of the Kirghiznin-Alatau. This valley is intersected by the River Nauruz and many of its affluents; its surface is undulating, and its rich black soil is covered with luxuriant pastures; but neither trees nor bushes grow upon it; its elevation is very nearly 5000 feet. This valley is remarkable for the plainly discernible moraines of ancient glaciers, similar to those of the Kastek already described; their summits protrude from the superincumbent deposits in regular lines of boulders, at the opening of the transverse valleys into the longitudinal one; the denudations at the rivers display unstratified clay with boulders, to a depth exceeding 80 feet. *Terminal* moraines occur here. The heights composed of unstratified clay, with boulders along the valley of the Issyk-kul, appear to me to be lateral moraines, and I consider the inclined strata of sandstone and conglomerate in the mountain promontory to belong to the Permian formation. The strata at the River Nauruz contain gypsum and rock-salt. The latter completely resembles lake-salt, being equally grey and muddy, and being mixed with black mould. In this part of the Kirghiznin-Alatau, we met with a great number of Kirghiz "aùls," of the Sultu tribe, particularly in the valley of the Issyk-aty.

On the 18th (30th) May, accompanied by Mr. Frehse, an officer of the Mining Engineers, we entered by the Ala-medyn rivulet the valley of the Chu, at Pishpek, and proceeded as far as Merké, along the northern base of the Kirghiznin-Alatau. This chain rises gradually from the Buam defile to the River Ala-archi, which is about 12 versts to the westward of Ala-medyn. Perpetual snow rests upon it opposite Tokmak, at the River Shamsi. The elevation of the highest peak at Ala-medyn is about 15,000 feet. Captain Protzenko, of the Etât Major, who visited these localities in 1863, told me that he saw glistening streaks, which appeared to him to be glaciers, between the mountain-snows on the Alarchi peaks, but as he saw them from a distance of 60 versts this statement requires confirmation by closer inspection. For my own part, I saw nothing of the kind. The presence in the Kirghiznin-Alatau of perpetual snow, and of peaks rising to a height of 13,000 or 14,000 feet, continues as far as the Karabalta River. The range gradually descends westwards towards Merké, near which place, at the sources of the Ourianda, it is not higher than 9200 feet,

and has there no peaks. Farther to the westward, between the sources of the Chanar and Makmala, the range again rises rapidly above the snow-line, that is, to above 13,000 feet; but to the westward of Makmala it descends again to Aulié-ata, where its western extremity, Tek-turmas, rises only 150 feet above the level of the Talas, and about 2600 feet above the level of the sea.

From Merké (height 2100 feet) we again made excursions into the mountains, proceeding first up the Merké River. Here broken and twisted strata of red argillaceous sandstone appear in the forelands; where they join the succeeding stratum of limestone, they are uplifted vertically. The limestone is dark, hard, and flinty, and contains many fossils, chiefly of the *Spirifer*-group. In appearance, the latter strata seemed to me to belong to the mountain limestone, and consequently to the Carboniferous formation. However, I can only confidently assert that the limestone is Palæozoic; I cannot positively determine the formation.

The River Merké, flowing in a narrow fissure through the limestone, has a very uneven bed, strewn with small sharp stones, which make it very painful for horses. Frequently there is no road except along the bed of the torrent. We therefore left this ravine, and again ascended the mountains, up the Ourianda River, in the direction of Kyr-Djol Pass, which is the lowest elevation in this portion of the range.

At the two first Ourianda rivers, and at the sources of the third, the limestone forms hills, which, though rather declivitous, are not rocky, owing to which they can be easily traversed. They are covered with luxuriant grasses, and afford excellent pastures; high grasses, the mountain-poppy and the peony ascend to 7500 feet, that is, to the limit of snow in the ravines at the latter end of May (O. S.). In August (O. S.) this part of the range is quite free from snow; but at the end of May (O. S.) the pass itself is disencumbered of snow, and presents rich spreading grasses, with a number of flowers of Alpine habitus.

Trees (*Juniperus pseudosabina*) were only found near the second Ourianda, and they stood in small detached clumps, which contained also bushes of the black-currant (*Ribes* sp.). The third Ourianda flows through a narrow and deep fissure in the limestone, the walls of which rise almost perpendicularly to the height of 100 feet. The bottom of this abyss, as well as even the slightest projections of the rock, is thickly overgrown with bushes of the mountain-ash, black-currant, &c. The hawthorn also occurs below, and juniper trees a little higher up.

In some places the edges of the precipices form bare, smooth, perpendicular walls.

The sandstone headlands are neither rugged nor steep, and are clothed with grass; no bushes, however, are to be seen, excepting different varieties of the briar, which all bear a yellow flower. The grass on these outlying hills is also scantier than on the limestone elevations which are not rocky.

The sandstone formations are succeeded by a sharply-defined stratum of limestone, and above this the crest of the ridge is impregnated with crystalline formations. These extend uniformly from Tokmak to the end of the range at Aulié-ata; and by them, assisted by the sections surveyed, one could easily trace and mark down the geological formations of the northern declivity of the Kirghiznin-Alataù, which are distributed in regular order.

Entirely different is the formation of the southern declivity. Here, between the Talas and the chief crest, is a whole network of small ridges, which are still insufficiently explored and defined on the map, especially at the River Ken-Kala, an affluent of the Talas. Here, at the foot of the range, the oldest crystalline rocks prevail, intermingled with those of subsequent aqueous origin; their extension is not parallel with the main axis of the range, which runs E. 10° S., to W. 10° N., but at an acute angle from this axis E.N.E.—W.S.W., corresponding consequently with the prevalent direction of the Thian-Shan range.

The southern declivity had been already surveyed in August, after many other expeditions; but for the sake of giving a complete description of the Kirghiznin-Alataù, I will here embody all the accessible information regarding it. On Tek-Turmas Point, near Aulié-ata, geological formations are denuded, viz., some black sandstones dipping southwards, which are not met with in the northern slope. These strata form the undulating plain of the Tek-Turmas, above which, at a distance of only 7 versts to the eastward of Aulié-ata, rise frequent and bare masses of porphyritic syenite, consisting of an equal mixture of small crystals of rose-coloured felspar and hornblende, with dispersed and larger crystals of felspar. The black sandstone is upheaved by this syenite, and the former alternates beyond, at Kara-archa rivulet, with argillaceous schist.

Up the rivulet in the interior of the chain, the black sandstone, syenite, and micous and argillaceous schists succeed each other, but the alternation of the different strata occurs still more frequently than the scale of the map admitted of being shown. The syenite in some places merges into almost pure felspar, with a hardly perceptible mixture of crystals of horn-

blende. Some occasional thin layers of micous schist contain crystals of garnet (granite). There are also layers of micous schist which change into argillaceous schist, without coming into contact with pure layers of the latter. Generally speaking, the stratified formations are all metamorphic; the strata are very contorted, partly overturned, and partly standing in a vertical position, so that it is difficult to determine their dip and extension.

The valley of the Kara-archa, which falls into the Kaında, an affluent of the Talas, is overgrown with small birch-trees; the large ones have been cut down for building purposes at Aulié-ata. The rocks are covered by the *Juniperus pseudosabina*, which plant extends remarkably low, viz., to 3150 feet, the lowest limit of the birch. Transverse valleys frequently occur farther on, but up to the sources of the Kaında they are generally treeless. From the mouth of the Kara-archa up along the Kaında, the stratified formations at the foot of the Kirghiznin-Alataù are penetrated by those of a crystalline character, namely, by alternating syenites and diorites. The syenitic formations here lose their porphyry-like structure, and assume their typical character, resembling granite. Transitions between both forms of syenite are frequently observed even in small fragments of from 3 to 4 inches in size. Fragments of diorite are also perceptible in the syenite, showing that the former had penetrated into the latter.

The metamorphic formations penetrated by the syenites and diorites appear in the Cha-archa ridge, between the Kaında and the Talas, and, at the same time, alternating strata of black sandstone and of argillaceous and micous schists, which prevail at the mouth of the Kara-archa, also occur. The micous schists appear only in the eastern or most elevated portion of the range, which rises in a high steep wall, and joins the Kirghiznin-Alataù by means of the above-named crystalline formations (this being more particularly observable on the water-parting between the two affluents of the Talas, viz., the Kaında and Chaaldanynsu). The latter rivulet flows across a transverse narrow fissure of the Cha-archa ridge. About 45 versts to the westward, the Talas breaks through another transverse fissure of the same ridge, but in an opposite direction, viz., from south to north.

The road from Kara-kol to Merké ascends along the Taldy-bulak rivulet, an affluent of the Kara-kol. Its valley is bare, as is also the opposite descent down the other Taldy-bulak,*

* Two rivers issuing opposite one another from opposite slopes always receive one and the same name from the Kirghizes. Thus there are two Taldy-bulaks, two Kara-archas, two Mak-malas.

one of the upper sources of the Kara-kyspak. The valley of this northern Taldy-bulak commences in a crater-like expansion, covered with good pastures, out of which flows a small stream through a narrow gorge, between rocks of syenite and diorite. Of these rocks the whole of this range is composed.

The outlet of this gorge disclosed to view the longitudinal valley of the upper Kara-kyspak, along which flow, and in which afterwards also unite, its two upper sources, viz., the western Taldy-bulak, and the eastern, or the Kara-kyspak proper; the latter river being the longer, and having the more copious stream. The direction of the valley is from east to west, with a length of about 35 versts and a breadth between the ranges of about 8 versts; its surface is undulating, and a row of hillocks extends parallel with the longitudinal axis of the valley from east to west.

These hillocks consist of unstratified clay, intermixed with small boulders, and in them also I recognise moraines of ancient glaciers; particularly as the transverse valleys which run from the south into this longitudinal one evidently commence, as I observed in the Taldy-bulak valley, in craters or hollows,—a condition favourable for glaciers. These ancient moraines are covered with a somewhat scanty steppe vegetation, in which a *Ceratocarpus*,* called “ibelek,” a pasturage grass, abounds.

After the confluence of the upper sources of the Kara-kyspak the river breaks through the northern chain of the Kirghiznin-Alatau by a narrow and almost impassable gorge. The road does not run through this gorge, but ascends to the third Eastern Ourianda: first by a narrow ledge along the southern slope of the northern chain; then trending through a small valley along the same slope it crosses, at an elevation of 8000 to 9000 feet, a high and rocky ridge, a spur of the northern chain, overgrown with juniper-trees, which afford cover to innumerable hares (*Lepus tolai*). Continuing along a ledge of this spur, it ascends the chief pass to the Ourianda, the descent to which northwards is already described.

The southern declivity of the northern chain presents the same syenites and diorites as exist in the valleys of both the Taldy-bulaks. From these central crystalline masses certain veins run into the limestone of the northern slope. The crystalline formations crop out through each other here, as along the whole southern slope of the Kirghiznin-Alatau. The veins of syenite run into the masses of diorite, and the syenite is itself impregnated with veins of granite; but besides these well-marked veins and fragments of broken formations, such as

* This species, doubtless, must be the *Ceratocarpus arenarius*. The “ibelek” is the same grass on which the Kirghizes feed their cattle in their winter pasturages.

diorite in syenite, diorite and syenite in granite, there are also gradual transitions of one crystalline formation into another.

The view southwards from the northern chain of the Kirghiznin-Alatau, at the Ourianda Pass, is magnificent. Immediately below, ledges of rock, overgrown with juniper-trees, hide the valley of the upper Kara-kyspak; beyond, rises the southern range of the Kirghiznin-Alatau, like a dark crenelated wall, as in the month of May (O. S.) it is already free from snow. Farther back still are seen the seemingly close and colossal snow-capped mountains of the Urtak-tau, glittering in the sun. They are particularly beautiful at the end of May (O. S.), when all that is seen of them from this mountain pass is covered with snow and contrasts distinctly with the black range which obstructs the view of their base, while their outline stands out in bold relief against the dark-blue sky. The snow in August rests only upon the topmost summits.

To the north, several snowless spurs of the Kirghiznin-Alatau are visible from this pass. They decline towards the Chu Steppe, and beyond them the boundless extent of this steppe blends with the heavens in the far horizon.

Such is the Kirghiznin-Alatau. Judging from what I saw of it, it consists of two principal ranges: of a southern, almost exclusively of crystalline formation; and of a northern range, for the most part of sedimentary origin. They are both intersected by rivulets between Aulié-ata and Merké; amongst others, the Ken-kol makes its way through the southern range, and, issuing from the longitudinal valleys, terminates its course at the syenitic hills at Tek-turma. Through the northern range, and issuing from the southern, rushes, as we have seen, the Kara-kyspak.

Let us now consider the localities at the base of the Kirghiznin-Alatau north and south.

Along the northern slope, between the sandy submontane region and the smooth steppe, there is another hilly zone of about 15 versts in breadth. Its soil is a sandy loam, mixed with boulders, chiefly of crystalline structure; and in this zone, between the rivers Djarsu and the north Kaında, flowing towards the Talas, there are visible moraines of ancient glaciers, similar to those existing in the longitudinal valley between Issyk-kul and Ala-medyn, which have already been described.* These mounds of drift have been principally formed

* In both these localities identification of the moraines is still more certain than on the Kastek, where the aggregation of granite boulders beneath rocks likewise granitic, might seem to favour the supposition of their having been so deposited by a landslip. Here, however, the granite boulders lie under sandstones and limestones, and the water from the annual melting of the present snows is powerless to remove them.

from the detritus washed down from the mountain-ranges. Their unstratified clay is interspersed with boulders; and, although they seem to me to be of glacial origin, they do not everywhere present the appearance of unmistakable moraines. They have probably been partly destroyed and washed away by the water from the dissolving ancient glaciers. The greater portion of the pebbles in the beds of the mountain-torrents has been washed out of the moraines of the glacial period, and not directly from the rocks. Thus the Kara-kyspak at its upper course does not flow over crystalline formations, but upon an alluvial soil, containing, however, boulders of crystalline formation. Further on, huge masses of limestone crop out; but there are few of these in the bed of the river after its issue from the mountains, nor are they more frequent in the beds of other rivers forcing their passage through the same sandstone, such as the Merké, Ourianda, &c.

The soil of this hilly zone, at the northern base of the Kirghiznin-Alatau, presents visible traces of its formation from crystalline elements, limestone, and sandstone. It consists of a light, sandy, calcareous, argillaceous loam, of which the proportions of clay and sand greatly vary.

Eastward of Merké, the loamy soil is chiefly of a yellowish colour; westward, it changes into a greenish marly mud, which is equally fertile under irrigation, but yields only a poor vegetation without such assistance. Opposite several mountain valleys there are tracts of black mould, but they are only found to the eastward of Merké.

From what I saw in the Issyk-kul valley, it appears to me that this black mould owes its origin to mountain forests, which for the most part are no longer in existence. They probably grew in a moister atmosphere than the present, during the glacial period and soon after it, as the glaciers here did not descend to the level of the sea which then covered the Kirghiz steppe, their lowest traces occurring at a height of more than 2000 feet above the Almaty and at the Kainda River.

The water-parting between the Chu and Talas, at the northern slope of the Kirghiznin-Alatau, is remarkable. It consists of a hardly-perceptible elevation of alluvial soils, intersected by hollows, of which some are transverse, sloping on both sides, and are filled in spring from the hollows running longitudinally with the elevation. This water-parting is situated between the Temdul rivulets, the affluents of the Chu and Djarsus, and the affluent of the Talas. The highest part of the range between Merké and Aulié-ata is to be found opposite this water-parting. Northwards, this low water-parting widens out

into a broad sandy plain, with a few wells, but without any running streams: these only border the plain.

The southern slope of the Kirghiznin-Alataù abuts on the valleys of the Talas and of the upper Susamyr. The first of these only has been surveyed. It is generally much higher than the base of the northern slope, and presents a steppe-like character, excepting in the wooded hollow forming the river-basin.

The valley widens out after the confluence of the Utch-kosh-sai with the Kara-kol, both of which flow through narrow, wooded, rocky valleys, and have altogether the character of mountain streams. The Talas itself, after their junction, passes through a rocky chasm. The woods along its valley descend to the mouth of the Chaaldanyn-su, viz., to a height of about 3400 feet, and are joined by other wooded ones which mark the course of its affluents. The trees consist of the poplar (*Populus sp.*), resembling the Russian ash, with several varieties of the willow; the bush species being represented by the *Hippophaë rhamnoides*, hawthorn (*Cratægus sp.*), and white willow. The streams of the Talas and Kara-kol are frequently divided into channels, and form wooded islands. The river-basin consists of rich mould and sand. Wild boars and badgers are found in these parts. The Kirghizes encamp here during the winter season.

Up the courses of the Utch-kosh-sai, Kara-kol, and along the affluents of the Talas, where their valleys assume the character of mountain clefts, the birch (*Betula sp.*, not the European) is added to the poplar; but higher still the latter disappears. The lowest limit of the birch evidently depends upon the nature of the valleys in which it grows, for it flourishes at different elevations in different valleys. By the River Kara-archa the birch is seen at a height of 3200 feet, and on the Kara-kol I did not see the last of the genus even at a height of 4800 feet.

The Talas flows in a single channel, covering nearly the whole width of the defile in the Cha-archa Mountains—not more than 25 to 30 fathoms—between black rocks of bare schist, rising almost perpendicularly 1000 feet above the level of the river, leaving scarcely room enough for the road from Aulié-ata to Namangan. The few and very small islands, tufted with a thick brushwood, in the rushing waters of the Talas, appear, from their contrast with the dark surrounding rocks, like emeralds in a silver setting.

After breaking through the Cha-archa, the Talas, throwing off arms and forming islands, for the most part covered with luxuriant meadows, still continues to follow direct north to the

base of Tek-turmas; after leaving which it proceeds towards the north-west to Aulié-ata, where, skirting Tek-turmas, it proceeds in a direction towards north-east. Below Aulié-ata the Talas emerges into the steppe. Through 8 versts of its course it is bordered by town-gardens, and beyond these its banks are lined with reeds. Here, in its issue into the steppe, the Talas preserves the character of a mountain river; and in a number of limpid streams it runs rapidly over a pebbly bed, crossed by innumerable fords.

High water, but of very changeable level, prevails from May to the middle of July (O. S.), owing to the melting of the snow in the mountains where the Talas issues and receives all its affluents. The water is lowest at the beginning of September (O. S.). There is, again, an accumulation from the autumnal rains, which at elevations of more than 5000 to 6000 feet are soon replaced by melting snow. I cannot say how far into the steppe the Talas retains its character of a mountain stream; its lower course had not been surveyed up to the 1st (13th) January, 1865.

The Lake Kara-kul, into which this river disembogues, is merely a network of spreading pools among sand hillocks: such, at least, M. Patanin observed it to be on his way from the Chu to Chalak-kurgan.

In volume of water the Talas is not much inferior to the Chu. All the streams running towards it (and they are numerous) reach its bed; whereas below Tokmak only two rivers run into the Chu, viz., the Ala-medyn and one other, in all probability the Karagaty. This is probably owing to the Talas flowing in a single channel in its lower course, and not spreading out into a series of lagoons occasionally uniting with each other: but, on the other hand, it is to be borne in mind that 50 versts below Aulié-ata this river enters upon the sands. These sands by the river, at the lower course of the Talas, the Kirghizes consider to be good winter grounds, and they are therefore occupied by their "aùls." As to the lower course of the Talas, the Kirghizes say that it reaches Kara-kul in a single bed, but that it is very shallow, and is frequently silted up with sand.

The connexion of the Kirghiznin-Alataù with the Urtak-taù, noticeable, as has already been observed, at the Upper Talas, I had previously explored at the end of June (O. S.), during an excursion from Aulié-ata to the head of the Chirchik, along the road to Namangan. This connexion is formed by the Charcha ranges here described, and by the northern submontane region of the Urtak-taù.

The road leads from Aulié-ata up the right bank of the

Talas to the Cha-archa Mountains, along cultivated fields, irrigated by canals from the Talas which commence in the very gorge; it then passes through this gorge near the Chemget rivulet towards and along the River Kara-bura.

The Chemget rivulet is distinguished by the fact of its rising in a plain. It rises from several springs, and runs into the Cha-archa range, emptying itself through a cleft into the Talas in the midst of these mountains. Farther on, the road to the Urtak-tau winds along through fields irrigated with water from the Kara-bura, which gives its name to that part of the mountains where it passes. The issue of this river from the mountains is at a distance of 40 versts from Aulié-ata. The first geological formation that crops up in the mountains is a loose unstratified conglomerate of red clay, mixed with a variety of pebbles; then vertically-uplifted strata of black argillaceous schist. In the steppe, at the approach to the gorge, are forts of clay, erected by the Kara-Kirghizes. At the very mouth of the gorge, and before coming to the denudation of argillaceous schist, there is a spring and a small copse of old and large poplars (*Populus sp.*, as on the Talas, a medium between the common poplar and the ash). A similar copse appears 8 versts higher up, at the confluence of the two affluents of the Kara-bura.

Through all this extent the Kara-bura flows still in the submontane region of the range, which is also composed of conglomerate, but stratified; the strata dip about 30° s.s.w. towards the range. At the confluence of the sources of the Kara-bura argillaceous schist again crops up.

The road beyond proceeds up the Ketch-kene-kara-bura River, along the eastern summit, for more than 30 versts between bare and uniform rocks, in which argillaceous schist alternates with thin strata of dark-brown limestone. Both these formations are devoid of organic remains. The stream is very rapid; the valley exhibits patches of meadow-land; but at first no trees, and only small prickly shrubs (*Caragana sp.*), somewhat like what are seen on the Syr-Daria and bearing similar pink flowers. This plant grows chiefly at elevations of from 4000 to 5000 feet. It occurs lower, but not higher, and does not descend to the lowest limit of the birch, which latter, at a height of 5200 feet, extends first along the crags covered with detritus, from the left bank of the Kara-bura, in a horizontal line, for about 1 verst, and keeps to the valley of the river, which, higher up, is wooded. The river itself flows direct from south to north. The birch-trees are not, however, high; they are crooked and their tops are broken, probably by snow-slips.

We may observe that the lowest limit of the birch-tree here (5200 feet, *possibly* 5300) corresponds with the lowest limit of the fir (5300 feet) in the eastern Kirghiznin-Alatau.

In this comparatively wooded portion of its valley the Ketch-kene-kara-bura breaks in several places through narrow clefts, where the road overhangs precipices of 50 to 60 fathoms deep. Here the foliage of the trees below is thicker than elsewhere.

At an elevation of about 7000 feet are found the first indications of the *Juniperus pseudosabina*. Three versts farther, at a height of 7400 feet, is the junction of the two heads of the Ketch-kene-kara-bura River; and the road trends round the eastern one to the left towards the pass, following generally for 2 versts the bed of the torrent, which here, falling at an angle of 10° to 15° , leaps with terrible rapidity from stone to stone, between birches and flowering bushes. Here, however, the river is close to its source, and there is but little water; consequently, notwithstanding its rapidity, the stream is fordable.

On emerging from the gorge the wide basin of the Kara-bura opens before one, the converging wooded valleys of which river are separated by sloping passes.

Here only on the Kara-bura, at a height of 8000 feet, is found the mountain-ash;* but its highest limit corresponds with that of the birch and the high-trunked juniper at 8700 to 8800 feet. The former elevation was measured along the road; in the side valleys, which are more sheltered, the forest ascends somewhat higher.

The rise of the slope at the bottom of this basin is not more than 1000 feet in 5 versts; but it is steep towards the pass, viz., 1500 feet in $1\frac{1}{2}$ verst. Here are Alpine pastures and creeping detached juniper-bushes; and here, by undulations and grassy declivities, close to the range itself, are easy passes over the heights of one valley to those of another; whereas lower down the valleys are separated by steep and hardly traversable or wholly impassable cliffs. Here, at a height of 9000 to 11,000 feet, are the summer pasturages of the Kara-Kirghizes; and when we travelled here at the end of June (O. S.) the pastures along the Kara-bura and its eastern source were all consumed to a height of nearly 10,000 feet. Moreover, the cattle are always driven through this locality from Aulié-ata to Namangan. The Kirghizes encamp on both sides of this road when they leave the route along the ridge of the mountains.

* In the Kirghiznin-Alatau, as we noticed, the juniper and the mountain-ash descend considerably lower.

Above 10,000 feet, we found on the 22nd June (4th July) that the snow had only just disappeared. There was as yet no vegetation; in the hollows there were large patches of snow. These patches lay there for several weeks longer, but the snow became porous and waterlogged and the intervening spaces were covered with alpine vegetation in full bloom.

On the same day the pass itself was free from snow to a height of about 10,500 feet. The ridge of this pass is saddle-shaped, rising at both ends into the region of perpetual snow; and here, as I remarked later, viz., in July and August (O. S.), the line of perpetual snow is at the height of about 12,000 feet.*

On the 23rd June (5th July) we observed from the ridge a herd of "teks," or mountain-goats (*Capra Siberica*, or another kind) on the slope. We did not succeed in killing any. "Ullars"† (large-sized partridges, weighing from 10 lbs. to 15 lbs.) are found at the same altitude in the summer. The latter escape pursuit by running quickly up steep declivities, in order to rise and take wing beyond the reach of shot; so that the sport of shooting these birds is difficult and fatiguing. It is a remarkable fact that the "kikelik," or red-legged mountain partridge, which is common in all the mountains between the Chu and Syr-Daria, is not to be found on the mountain-ridges of the Urtak-tau; and it is also remarkable that on the Kara-bura alone I fell in with the dark-brown sea-sparrow of the Kuriles and Aleuts (*Cinclus Pallasii*); whilst on the southern slope of the same mountains, as well as in the Kirghiznin-Alatau, I saw only the "altayan," or white-bellied variety (*Cinclus leucogaster*) of this species of bird.

The valley of the Kara-kyspak is the most picturesque of all those that I saw in the Western Thian-Shan. The descent towards it from the pass is steep; and instead of running straight down, it proceeds along the side of the mountain, and the path leads on along the edge of an almost perpendicular cliff, which rises sheer from an abyss 900 to 1000 feet in depth. The summit of the pass is not more than $1\frac{1}{2}$ fathom wide; and in proportion to its height above the abyss of 1000 feet, it may be compared to the blade of a knife. The descent follows a north-easterly direction, and does not lead to the issue of the Kara-kyspak, but to the confluence of its two sources. Farther down, the road proceeds along that river towards the south-east.

The valley of the Kara-kyspak, like that of the Kara-bura, first takes the form of a great hollow, divided by undulating

* Measured on the Urtuk-tau by angles from the Talas valley. The note of more accurate determination has, unfortunately, been lost.

† *Megaloperdix* of Brandt. I shot only a couple of the *Megaloperdix nigellii* var. on the summits of the Ourianda, in the Kirghiznin-Alatau.

ridges into several converging valleys. This hollow is walled up towards the west by a steep snowless declivity, along the face of which runs the descent from the Kara-bura Pass mentioned above. On all other sides rise snow-clad summits, nearly flat above the snow-line, but very steep below the level of snow. All these declivities, except the precipitous western side, are clothed with the soft fresh verdure of Alpine pastures. Spreading juniper-bushes are scattered everywhere, growing more especially in clefts. But in the lower part of the hollow, the Kara-kyspak, 100 fathoms below the confluence of its sources, where it still traverses the upland meadows, pours into a deep bed about 50 fathoms below the level of the meadow-land; after which it enters a regular gorge, through which it runs for about 17 versts, and receives on the right and left a number of streams from the lateral valleys. Thus, in the seventh verst of its course through the gorge, it becomes a torrent about 10 fathoms wide and 3 feet deep; rushing with a roar over the stones, between perpendicular walls. The lateral valleys are everywhere surrounded by snowy summits, and abundant springs pour their waters into the river over the walls of the gorge, which are more than 100 fathoms high, in frequent though narrow streams, resembling strings of silver between the rich green verdure of marginal brushwood. The river itself, swollen more and more by the streams of the gorge, and from torrents of snow-water, leaps and foams in one incessant cataract, between stupendous rocks several hundred feet in height, crowned by perpetual snow.

Snow-slips occur within 7 versts of the confluence of the sources of the Kara-kyspak, and they continue for about 10 versts further. The avalanches depend upon the form of the snow-clad summits above the gorge; their comparatively sloping sides (of 20° to 25°) terminating abruptly in almost perpendicular sides of crevices. Immense masses of snow accumulate in the hollows, and sliding down the declivities tumble into the gorge of the Kara-kyspak. This occurs in the spring, in April and May, according to the condition of the latest, or surface snow of these masses; which, by the end of June (O. S.) becomes water-logged. With the thaw it becomes pink, and gives birth to unilocular microscopic plants (*Protococcus nivalis*). These masses, tumbling annually, and always at exactly the same places, do not, however, obstruct the river, so as to dam it up until it again forces its way through; but, on the contrary, they form permanent bridges of snow, with regular semi-circular arches over the river; and there are no signs of the stream having been blocked up, or of the sides of these arches having been washed by the waters. It is

everywhere easy to distinguish the yearly layers of snow; as each new avalanche descends upon the masses that were hurled down during the two preceding years, and which have become consolidated by the winter's frost succeeding the summer's thaw. Each of these bridges is sufficiently strong to bear the shock caused by the later falls; in a word, each avalanche falls upon a firm and permanent natural bridge of snow. These bridges almost always preserve the same dimensions; the addition of snow to the top being counter-balanced by the melting away of the inner part of the arch, and by the subsidence of its piers where they rest on strongly heated rocky ledges.

I always noticed three yearly layers of snow, either more or less; each being of the thickness of several fathoms, the bottom one being the thinnest. Consequently, the accumulation of each spring melts away in the course of two years.

There are in all seven bridges. The upper one is the smallest, and the two centre ones the largest, being each 400 to 500 fathoms across. The lower of these is at an elevation of 8650 feet, the lowest of all is 1200 feet below.

At the last but one of these bridges, where there is a bend in the gorge, the water has the appearance of being obstructed by steep and colossal snow-clad mountains, turret-shaped at their summits. This is the Namangau range on the left bank of the Chirchik; and its nearest snowy peaks are still 15 to 20 versts distant. Beyond this the gorge opens out into its lower hollow, and then again contracts. Here the Kara-kyspak passes under its last snow-bridge; and 3 versts lower down, enters the valley of the Chatkal, and merges into that river.

In the 20 versts of the course of the Kara-kyspak from the confluence of the two sources, to its mouth, the fall of the river equals 2500 feet; more by 125 feet to the verst than the fall of the Imatra which is not more than 30 feet to the verst, but its volume of water is less.

In the hollow last mentioned, and more especially on the right-hand side, the rocks retreat to nearly a verst from the river, which flows between hills of unstratified clay and boulders, several hundred feet in height, forming a slope between the rocks and the bottom of the hollow. These hills are covered with enormous parachute-shaped plants (*Umbellifera*, probably *Ferula sp.*), which shade also the southern submontane region of the Urtak-taù, composed of similar drift. The highest limit of those plants is about 500 feet above the level of the river in this locality, and therefore, about 8000 or 8100 feet above the sea-level. Here on the 20th June (11th July), I saw the ground covered with snow that had fallen during the previous night, while lower down by the river rain was falling.

Generally in the months of May and June (O. S.) the rains

are frequent at heights above 4000 to 5000 feet. They occur almost daily between four and seven in the afternoon: not so often in the morning or at night, and in June higher up the mountains than in May. Beginning from an elevation of 8000 feet, or a little below, during all the summer months it alternately rains and snows, but the snow soon melts. Above 9000 to 9500 feet rain never falls, but only snow; although here in summer the snow melts soon after it falls, or even in falling. This upper limit of rain is also the extreme limit of forest and of brushwood. Alpine grasses, and the spreading juniper alone are irrigated all the year round with snow-water only.

The rhododendron * which on the Alps and Caucasus grows abundantly above the upper limit of forest, and which in Siberia grows in the mountain forests, I did not fall in with either in the Kirghiznin-Alatau, or the Urtak-tau, at least not at these elevations. The upper limit of the birch at the Kara-kyspak is considerably lower than at the Kara-bura, viz., at 7450 to 8700 feet, which may be attributed to the fact that the entire valley of the Kara-kyspak winds between snow-clad mountains screening it toward the south-east and south-west. Three versts below the commencement of the forest, at a height of 7100 feet, the Kara-kyspak falls into the Chatkal; it is nowhere fordable in this later period of its course.

The valley of the Chatkal has less of the steppe character than that of the Talas. Copses of wood grow, not only at the sources of the Chatkal, but are sprinkled over the spaces between them, and near the hollows, moistened by springs. Even the lands along the river are also wooded. There are frequent patches producing birch, willow, and a variety of brushwood unknown to me, but amongst which I could distinguish the mountain-ash and black-currant bush. To these, at an elevation of 6350 feet, is added the (*Hippophae rhamnoides*), which rises to the great height of 2 fathoms; and the hawthorn, at an elevation of 6000 feet. The banks of the river here are steep, and are 10 to 15 fathoms in height; they form the first rise towards the mountains, the second consisting, as I have stated, of hills of drift; the unstratified clay and boulders of which appear to me to be of glacial origin.

The current of the Chatkal is extremely rapid throughout 30 versts. From the mouth of the Kara-kyspak to Chipash-Kurgan, it falls 750 feet; † there are no fords. The width of the principal current is 20 to 25 fathoms; its smaller side-

* There are no rhododendrons anywhere, either in the Thian-Shan or in the two Alatau.

† The fall of the river from the mouth of the Kara-kyspak to Tashkend, is not less than 5000 feet throughout an extent of 270 versts.

channels are insignificant. The Chatkal or Upper Chirchik distinguishes itself from the many-armed Talas by the far greater concentration of its waters into one swift current. It has besides a greater volume of water, being fed by incomparably larger masses of snow, particularly in the Namangan range, as well as the Urtak-taù, the southern valleys of which do not, like those on the north, intersect a declivity generally snowless, but traverse the wide snow-plain forming the summit of the range; as is seen from a comparison of the Kara-Kyspak and the Kara-bura; and along the whole of the Chatkal, as on the Kara-kyspak, the perpetual snows upon the spurs, between the transverse valleys, commence at four or five versts from the bases of the mountains.

The current of the Chatkal, notwithstanding its velocity, is smooth and free from waves, and is, therefore, serviceable for floating down timber to Tashkend.

The Chatkal is formed by the Kara-kyspak and Kara-kuldja; the latter itself originating from the confluence in one valley of several torrents issuing from the mountains. These streams mostly rise in the short meridional range or mountain-knot, covered with vast masses of snow, between the Urtak-taù and Namangan ranges. From both of these the Chatkal receives many affluents every 3 or 4 versts. The Namangan range is loftier than the Urtak-taù; and even the heights near its base ascend 15,000 or 16,000 feet. More than half its height is covered with snow. Taking the snow-line at the end of June (O. S.) at 11,000 feet (from a measurement of the snowless pass of the Urtak-taù), and the foot of the mountains as 6500 to 7500 high (about 500 feet above the level of the Chatkal), we obtain from the base to the snow-line a height of 3500 to 4500 feet.

The crest, however, of the Namangan range (i. e., the average height of the intervals between the peaks) is not higher than that of the Urtak-taù; but the peaks of the former rise higher than those of the latter.

Between these peaks are noticeable the cloven sides of the mountains, which are almost perpendicular; and on which for several thousand feet the snow does not rest. The peaks, which are either sharp-pointed or in the form of crenelated towers, with upper snow-covered platforms, and "counterforts" also snow-clad, are remarkably diverse and picturesque.

Within so grand a framework of snow-covered mountains, upon which the clouds are ever collecting, clinging to the crags, and then gradually dispersing, lies the beautiful valley of the Chatkal; and its loveliness is enhanced by the bright blue sky overhead. The river, clear and rapid, runs glittering along

through meadows of verdant green, sprinkled here and there with copses. But it is this green verdure in the vicinity of such masses of perpetual snow that leads me to suppose that the valleys of the Chatkal must be subject to severe and prolonged winters.

The huts of the Kirghizes in the meadow lands by the river ascend to the height of 6400 feet, consequently not much beyond the limit of the *Hippophae rhamnoides*. Here are seen the enclosures for their cattle, formed of heaps of broken branches of brushwood. There are no traces of permanent habitations, from which we may conclude, that here also the Kirghizes pass the winter in their summer felt "kibitkas;" as I afterwards observed in the western part of the Trans-Ili-Alatau, near Suoktiubé. The Kirghizes, who encamp along the Chatkal for the winter are of the Saru section of the Kara-Kirghizes.

I was able to descend the Chatkal 45 versts from the mouth of the Kara-kyspak to a point 6000 feet above the sea-level. Here it still flows in a south-westerly direction, but a little further on it makes a decided bend towards the west. Along its right bank runs only a spur of the Urtak-tau mountains. Between this spur and the principal chain there is another mountain-torrent, at the source of which *verdigris* has been discovered in the landslips. Mr. Frehse and myself saw the ore, but not the spot where it was actually found.

From the Chatkal we returned to Aulié-ata by the same route, along the Kara-kyspak and Kara-bura. We next examined the valley of the Arys, and the northern slope of the Urtak-tau, to the west of Aulié-ata; I exploring the Boraldai Mountains and the elevated table-land, and Mr. Frehse the northern slope of the Kara-tau.

From Aulié-ata we proceeded on the 7th July (19th July) by the Chemkend road, which at a distance of 12 versts from the town, intersects the River Asa, close to the southern foot of the small chain called the Ulkun-burul Mountains, appertaining to the Karatau system: About 5 versts from Aulié-ata, and enclosed by mud walls, are the townlands with small gardens scattered about. These are irrigated from the Talas. Next comes an extremely flat and barren watershed between the Talas and Asa; and a similar slope towards the latter river, from which a few irrigation canals are supplied, fringed with bright verdure, reeds and wild lucern (*Medicago sp.*), or, in the Kirghiz vernacular, "djan-shike."

Between these canals is a marl steppe, with a grey parched soil, covered by the poorest vegetation, and by withered worm-wood and sickly bushes of the *Ephedra*. The valley of the Asa is devoid of meadow-land, and is encumbered with boulders.

The river itself flows in many diverging streams of 8 to 10 fathoms in breadth, but of not more than 3 feet in depth. Judging from the river-bed, the waters of the Asa must, however, increase considerably in the spring, and must then be very turbulent.

Immediately beyond the Asa is a flat elevation, as barren as the right bank of the river, strewed with small boulders from the Ulkun-burul, composed principally of hard limestone and cornelian; the latter lying in thick strata in the Ulkun-burul.

On the first slope from the Asa, and by the side of the first "aryk" (or canal) of this river, is a shady garden attached to an Aulié-ata summer residence which we found uninhabited. Surrounding it is a bare waste, over which reigns a death-like stillness, but the scenery is nevertheless grand, owing to the snowy heights of the Urtak-taù towering above the steppe. There is a perceptible decline in this steppe extending northwards to the right, and stretching towards the small lake of Ak-kul, into which the Kuyuk rivulet discharges itself. Saline plants appear here, with the *Salicornia herbacea*, at a height of about 1700 feet, calculated by the measured heights of the Kuyuk and Biliù-kul mountain-chains.

The mountains of the Kuyuk are composed of schist, covered with a poor grass; there are hardly any bushes except the wild briar. The road passes into these mountains by the rocky defiles of the Kuyuk rivulet.

Having ascended through this defile, we entered upon a flat table-land, along which flows the River Tersa, afterwards falling into the Asa. The descent from the Kuyuk Pass to the Tersa is very short, viz., about 3 versts, and is extremely gentle. On the summit of the pass are several springs; these are the most southerly sources of the Myn-bulak district, celebrated in the ancient geography of Central Asia, and which Huen-Tszan places not far west of the Talas. The high mountains mentioned by him, to which the district of Myn-bulak clings, are the Urtak-taù. This locality is celebrated from the fact that when Huen-Tszan visited it, in the seventh century after Christ, it was the site of the summer encampment of the Toorkish khans.* The Kirghizes, even now, consider Myn-bulak to be the best place for summer encampment between the Chu and Syr-Daria.

The large trees mentioned by Huen-Tszan no longer exist about Myn-bulak, but the summer there is still warm; the heat does not, however, exceed 25° R. There is good pasturage,

* See Humboldt's 'Central Asien, übers. v. Mahlman,' vol. i. part i.; chapters on the Thian-Shan and Bolor Mts.

with a dense and succulent herbage, and there are numerous clear springs.

From the southern slopes of the Urtak-taù, Myn-bulak, according to Huen-Tszan, is divided by the valley of the River Tersa; but the present district of Myn-bulak is separated even from the Tersa by a low ridge composed of schist. These strata, however, dipping from 25° to 30° N.W., and extending N.E., S.W., crop out in the bed of the Tersa.

The valley of the Tersa is rich in luxuriant meadows. In its course it has rather the character of a steppe river than of a mountain torrent, like most of the trans-Chu streams. It consists of lagoons of almost stagnant water, connected by rapid though noiseless currents.

The arms of the Talas are very insignificant, spreading out into small marshy pools. Waterfowl are plentiful on the Tersa, especially geese and snipe, while ducks are rather scarce. In the adjoining steppe are great quantities of sandgrouse* (*Pteroclaus arenarius*), and of bustards in the meadows along the river. In the winter I saw numerous traces of the wild-cat of the steppe (*Felis manul*), and of "corsaks" and other foxes. This river flows from the eastern declivity of the Kulan Mountains which belong to the Karataù chain, from one of the western ridges of which issues one of the sources of the Arys. The main sources of the latter river are, however, further south.

The Tersa does not possess many tributary streams. The principal ones flow from the Urtak-taù; the Ak-sai and Kok-sai from beneath the lofty peaks of the same name; but in its valley and even its bed are many springs.

The road from the Tersa to the sources of the Arys ascends obliquely a gentle slope of the Urtak-taù to the river. This slope is covered with drift, in which, however, I could detect no boulders; it is intersected by numerous ravines, streams, and rivulets.

At the Chak-pak, which is the last tributary of the Tersa towards the west, perpendicularly upraised strata of sandstone crop out above the drift. These are of an unascertained palæozoic formation; they occur on the right bank of the rivulet, which, however, soon makes a bend towards the north-east and intersects this sandstone. The latter extends almost directly from north to south. The left bank of the Chak-pak is composed of limestone, which also forms the pass to the valley of the Arys. This is most probably mountain-limestone, as lower down the Arys sandstone and schist, which to all appearance is of the Carboniferous period, rest upon it. In these Mr. Frehse

* A large white bird found in the steppes of South and South-east Russia.

found indistinct impressions of calamites in the spurs of the Boroldai Mountains, forming the right side of the valley of the Arys at the Kulan-su rivulet. Seven versts below this rivulet on the Arys there occurs a reddish argillaceous sandstone, probably of the Permian formation.

The valley of the Arys, like that of the Tersa further east, separates the Kara-taù mountain system from that of the Urtak-taù. The watershed between the Arys and Chak-pak, the tributary of the Tersa, connects the Urtak-taù with the Kulan Mountains of the Kara-taù system. From the Urtak-taù this watershed extends in a hardly perceptible elevation, which descends gradually towards the north. At the sources of the Arys a steep mountain of limestone rises abruptly on this elevation, and beyond is a saddle-shaped ridge; while still further on are to be seen the numerous rocky summits of the Kulan, which increase in height as far as the source of the Tersa, and decline further still towards the north. This Kulan chain is the Mynbulak-tau on Humboldt's map, attached to his work on Central Asia; and it was considered by him to be the extreme northern continuation of the Bolor—of which more presently.

At the southern foot of the mountain with which the Kulun chain commences are several deep springs, giving rise to considerable streams, which, after a course of from 2 to 3 versts unite to form the Arys. The volume of water increases very rapidly, as the valley abounds with copious and fast-bubbling springs. The rivulets also that fall into the Arys, on the right from the Kara-taù, and on the left from the Urtak-taù, are very numerous. The latter chain declines in height towards the west, following the course of the river, and at Yaski-chù, about 45 versts from the sources of the Arys, terminates in a precipitous ridge not more than 2000 feet above the level of the river, which has here an absolute height of 1950 feet above the level of the sea. Farther west, however, of this projection there is still a low platform of limestone, separated from the former by a flat arid valley, one verst in breadth. The small patches of perpetual snow that still extend on the Urtak-taù west of the sources of the Arys, are no longer visible opposite the mouth of the Sarybulak, at a distance of 20 versts above Yaski-chù. As to the mountains of the Kara-taù system that approach the Arys between its sources and Yaski-chù, they are simply the south-western slope of the Kulan Range, which terminates in a rather abrupt gradient at the River Arys. The deep valleys of the right tributaries of the Arys divide this slope into several seeming ridges, extending from north-east to south-west. Beyond these hills the principal chain of the Boroldai Mountains with

their craggy heights, extends in the same direction between the river of the same name, falling into the Arys, and the River Bugun, flowing into the Chilik, an affluent of the Syr-Daria. The Boroldai Mountains abut upon the Kulan Range almost at a right angle. From their form, and from the yellowish tint of their crags, they seemed to me to consist of limestone.

The Kara-taù system is joined to the Western Thian-Shan, not only by means of the connexion between the Kulan and the Urtak-taù, described above, but also by the link between the Kuyuk and the Cha-archa, which, as already mentioned, is orographically connected with the Kirghiznin-Alataù, and geologically with the same and with the Urtak-taù.

The upper course of the Arys terminates at Yaski-chù, where it emerges from a mountain valley upon a perfectly level steppe, or rather upon a steppe which almost imperceptibly rises from the edges of the river-basin; these edges on all sides frequently forming a precipitous gradient of 6 or 7 fathoms in height, which, like the bottom of the valley, consists of drift. The river itself flows on in a deep bed. As far as Yaski-chù it is rapid, running over pebbles, and is of equal but not very great depth. In this locality it forms lagoons deeper than the river (about 1 fathom), but running more slowly. Lower down these lagoons are more numerous and still deeper, and their alternation with fords characterises the middle course of the river, to the mouth of the Badam; the depth of the fords here is, however, less than 3 feet. The bed of the river becomes more and more muddy, although occasionally it is sandy.

The middle course of the Arys differs from the upper, from the fact of there being fewer springs in the valley, and that its feeders, although larger, are not so numerous. These are: from the right, the Boroldai; from the left, the Mashat and Badam. Chemkend is situated on the latter. There are, however, several other rivulets flowing towards the Arys between the Mashat and Badam, without reaching it—their waters being diverted into irrigation canals. The lower course of the Arys extends 70 versts from the mouth of the Badam to the Syr-Daria. The current here is slow, and the depth from the ford at the embouchure of the Badam gradually increases, so that the Arys becomes navigable for vessels of 4 feet draught. Copses of “djida” (*Eleagnus angustifolia*), “turanta” (*Populus diversifolia*), and of thorn (*Caragana jubata*), cover the banks of the Arys for about 20 versts up the river from the Syr-Daria.

We arrived at Chemkend in the month of July and descended the Badam, crossing the Arys from the mouth of that river. Here I parted with Mr. Frehse, who proceeded to Turk-estan, and thence, traversing the Kara-taù by the Turlan Pass,

went on to Cholak, made an excursion to the coal-beds at the Kumyr-tas Stream, south of Cholak, and returned to Aulié-ata by way of the steppe, along the northern slope of the Kara-taù. My course was along the Bugun up to its sources, where I crossed the Kara-taù, and made my way back to Aulié-ata by the Biliukul Lake and the Ulkun-burul Mountains.

I shall now describe these districts north of the Arys. Those to the south will be referred to further on, as I saw little of them in July, but examined them later in September. A few words, in the first place, regarding the valley of the Arys.

This valley is remarkably fertile, as well as the land on the left bank wherever water can be conducted; and this can be done everywhere in the valley without the smallest difficulty. By means of irrigation even the multifarious soils of the trans-Chu district, and of the Aralo-Caspian hollow—nay, those also which, without irrigation, do not produce a blade of grass, such as the grey clays of Khiva, or the red clays by the Ulkun-burul, near Aulié-ata—are made productive, and in some instances tolerably fertile. But the fertility of the valley of the Arys, with its luxuriant growth of lucern,* wheat, “djugara,”† maize, and “kunak,”‡ surpasses everything. The ears of the “kunak,” instead of being, as at Aulié-ata, $1\frac{1}{2}$ inch in length and $\frac{1}{2}$ inch thick, attain a length of 3 inches and a thickness of 1 inch. The grain is not of the size of poppy seed, as at Aulié-ata, but nearly that of millet. The “djugara” reaches a height of $1\frac{1}{2}$ fathom, and the stalks are of the thickness of two fingers; they grow close to each other, stalk to stalk, so that their roots become entwined. The Indian wheat is almost equally large, although it does not grow so thickly. Wheat produces thirty-fold; the lucern, after three cuttings, grows up again nearly 3 feet high, and is prevented from bending down by its density, the stalks supporting each other, the outer ones alone bending down to the ground. The melons and water-melons are really superb.

The hay-fields and natural meadows are not sown, but are merely irrigated. This fertility is greatly owing to the properties of the soil, which is a rich dark loam, loose, and easily ploughed, and retaining moisture; it is composed of clay, the finest sand, lime and decomposed matter. It has been formed

* “Dlany-shke” (*Medicago sp.*), perhaps the known Chinese Mu-sui.

† *Holcus sp.*, something like the sugar-cane. The stalks are not very sweet; the seed is used as grain, and the leaves are given to cattle, as well as the young stalks. The old stalks are used for fuel.

‡ A grass similar to *Alopecurus*. It is considered to be very good fodder for horses, especially if cut down while the seed is still unripe. The ripe seed falls out, and is too small for grain fodder. The Kokandians and Kirghizes, however, prepare it also as grain.

of granular particles of clay-schists and flinty limestones, blown down by the winds, the decomposed matter being probably the remains of forests which once covered the Urtak-taù, as we have had occasion to remark in allusion to similar soils between Tokmak and Merké. There are no woods along the Arys, excepting small artificial plantations of white willow, and partly of poplars in the valley. The soils on the left bank of the Arys, on the steppe uplands, and at the foot of the Urtak-taù, are also of good quality, and are quickly and easily covered with vegetation in the spring of the year, without irrigation. This, of course, becomes quite parched up in May, although it grows up in the condition of a passably good steppe hay-crop.

The last mountain declivities on the right bank, but only as far as Yaski-chù, are likewise covered with the same kind of herbage, growing in a similar soil. Further on, the steppe along the right bank becomes worse and worse, producing a scanty wormwood, and at last even "kali" between the mouths of the Boroldai and Badam, principally *Anabasis aphylla*; as yet there is no regular *Salicornia*. The highest limit of the "issegik" is here about 1550 feet above the level of the sea, near the mouth of the Boroldai; but it grows only on the lower decline of the steppe, close to the river itself, this decline being intersected by numerous waterless and precipitous ravines. The upper land, rising only 200 feet above the lower, is a rugged elevation, with a drifted sandy argillaceous soil, very dry and overgrown with scanty vegetation, consisting principally of *Festuca ovina*, interspersed with leguminous plants, particularly prickly *Alhagi camelorum*, an unwinding convolvulus, and small and meagre bushes of hawthorn (*Atraphaxis*). There is also a small proportion of wormwood. This elevation extends from the Boroldai Range, between the Boroldai and Arys rivers on the south, and the Bugun on the north. Similar steppe uplands rise also at the bases of the mountain ranges, and between all the affluents of the Arys. But to the north of this river each of these uplands assumes the form of several rows of rounded and gently sloping hillocks. Towards the south their form is that of elevated table-lands, intersected by deep and precipitous hollows; and they appear to me to have relation to the height of the mountains whence these deposits have been blown by the wind. To the south of the Arys especially the mountains are much higher, and the amount of deposit there is proportionately greater.

The valley of the Bugun into which we passed from the Arys, on our way back from the neighbourhood of Chemkend, is also occupied by meadows both natural and artificial, sprinkled with groups of willows, like the valley of the Arys. The cultivated plants are identical with those of the latter valley, but are not

so fine in their growth, with the exception of the water-melons, which ripen earlier. The soil is not so dark, and particularly the irrigation is less effective, as the Bugun Rivulet has very little water; at 30 versts from its junction with the Chilik its bed is dry. Fifteen versts higher up the water stands in pools; but there even only where springs ooze up. These become much more numerous towards the mountains, where there is a tolerably full stream. The Chilik possesses a more copious current; it flows from the higher part of the Kara-taù, near the head waters of the Bugun. Between the Kulan and Boroldai ranges, with their spurs to the south, and the properly so called Kara-taù group to the north-west, there is, connecting them, an elevated plateau, not higher, however, than 3500 feet above the level of the sea, ploughed by deep hollows. These hollows are overgrown with bushes, principally hawthorn, which occurs here in the form of trees, with straight and thick trunks, reaching a height of $2\frac{1}{2}$ fathoms, and attaining a thickness of $1\frac{1}{2}$ foot. This plateau presents two slightly sloping sides—one towards E.N.E., the other towards W.S.W., both terminating in steep declines. The western slope is intersected by the Bugun, which first flows westward, then southward, and finally westward again, continuing in that direction after issuing from the mountains. At the foot of the western slope there is a sub-range of low hills of crystalline limestone, intersected by the Bugun. Dipping E.N.E. towards this mountain-range are alternating strata of crystalline limestone and clay schist; then between the base of the range and the bed of the Bugun, from north to south, non-crystalline limestone, a blackish limestone-conglomerate, and again a greyish crystalline unstratified limestone. The road here crosses to the left bank of the Bugun, and the upper surface of the plateau discloses nothing but black conglomerate, the strata of which dip towards the west and extend N.N.W., S.S.E.

The eastern declivity abounds with springs oozing from under the conglomerate which forms the summit of the pass. The waterline is not formed by it, but by a gradient above it intersected by gulleys following a westerly direction. The waterline itself forms at the foot of the conglomerate slope a plain of 2 versts in breadth, with waterless springs; at its eastern edge are gulleys, with bushes, chiefly of hawthorn, among which the roe (*Cervus capreolus* Var. *pygarga*) is not uncommon. In these gulleys are to be seen deposits of limestone upon metamorphic clay-schist, from which issue streams running through the foremost range to the north-east, the commencement of the Ketchkene Kara-taù (Little Kara-taù); two similar ranges, a smaller one to the north of a larger or chief range, with an intervening longitudinal valley,

were observed by Mr. Frehse at Cholak considerably farther to the west. To the north-west, from the sources of the Bugun, the Kara-taù system contracts; instead of an elevated plain, intersected by gulleys, there is a steep jagged ridge of mountains: the direction of the waterline varies. Here is the commencement of the range, properly called the Kara-taù, which, as far as the Kumyr-tas Rivulet, follows a westerly direction, with a slightly southern tendency; it then stretches towards W.N.W. The Ketchkene Kara-taù is in its immediate vicinity on the north, being separated from the main range by a longitudinal valley; but in these neighbouring hills Mr. Frehse observed, on the road from Kyzyl-kul to the Kumyr-tas Rivulet, not strata of coal and sandstone, but clay-schist. Carboniferous strata crop up in the longitudinal valley. Actual black coal exists on the Kumyr-tas Rivulet, three seams having been discovered, two thin ones and another a fathom thick. They all dip towards the south at an angle of 45° to 50° .

In the schist accompanying these seams Mr. Frehse found a great many calamites. It appears to me, from the various observations made by that gentleman and by myself, that there are several small coal-fields in the Kara-taù system separated by upheaved metamorphic formations.

At 30 versts to the west of the Kumyr-tas, at the point of its bend towards the north-west, the Kara-taù narrows again, though rising higher at the same time, attaining here its greatest height of 7000 feet. The elevation at the Turlan Pass from Azret (Turkestan) to Cholak is, according to Mr. Frehse's measurement by means of a hypsometer, 6800 feet above the sea-level. This is about twice the height of the pass between the elevations of the Bugun. On this summit Mr. Frehse found detached pieces of white lead-ore, but he did not discover the strata of grey sandstone and black schist, with a tendency towards vein itself. According, however, to the account given by the natives, there are a great many veins in the neighbourhood. The ore, so far as is known, is extracted by the Kirghizes from the sides of the mountains where it is denuded; it is very easily reduced, the Kirghizes smelting it over brushwood fires. The lead is sold at Azret, whence it is taken to Tashkend, and further on into Kokan and Bokhara; it is sold at 3 or 4 roubles (9s. to 10s.) per pood (36 lbs. English), according to the quantities in which it is obtained, and to the demand. Mr. Frehse did not discover any crystalline formations; but in the southern slope he found sandstone, and on the northern limestone, the dip and extension of which, however, I have not learned from him. This is the reason why I have marked these formations only on my geological chart.

Forty versts west of the Turlan Pass, as far as Suzak, the Kara-taù preserves its altitude. Here the *Juniperus pseudosabina* grows to the size of a large tree—large, that is, for this region. The trunks yield timber of 2 fathoms in length and about 10 inches in cross-section. I may at the same time observe that the dimensions of this tree become greater and greater towards the west. In the vicinity of the eastern extremity of the lake of Issyk-kul the trunks of this tree are very thick; but they lie along the ground, the branches alone stretching upwards. The erect trunks in the Buam defile astonished Mr. Semenov. At Ourianda, in the Kirghiznin-Alataù, these trunks occasionally yield timber 2 fathoms long; but it is generally of shorter lengths, not more than 2 or 3 yards, though still of considerable thickness. Further to the south-west, on the Kara-bura, the trunks are generally high, viz., from $1\frac{1}{2}$ to 2 and even to 3 fathoms; and at Chemkend, still further to the west, I saw timber of 3 fathoms in length of the same juniper, which would lead one to suppose that there are still larger specimens to be found. As this timber was from 8 to 10 inches in thickness in the bark, the tree must be 2 feet thick. These timbers were brought from the heights of the Badam; I was not there, so I have not seen the trees growing. But the tall common junipers that I saw have generally a trunk without any branches below half-way up; above this height the branches are numerous, short (one-fourth, or less, of the height of the tree), and of slight thickness; the top of the tree is generally broken off. The increasing size of the juniper towards the west in the Thian-Shan corresponds with Darwin's theory of the mutual competition of species of animal and vegetable life. As I did not see the juniper in the regions of the *Picea Shrenkiana*, I can imagine no other explanation. I will only observe that, in the lower woodlands on the mountains, its exclusion is not attributable to physical conditions, but to the presence of the fir and birch. On the Kara-archa it grows sporadically at an elevation of 3000 feet below the birch, and above it on the crags; and, what is remarkable at this extreme of the lowest limit, it lies along the ground, as it does at the uppermost limits. The best and thickest specimens that I saw were at an elevation of 7000 to 8000 feet.

Near Suzak the submontane region of the Kara-taù is covered with forests of saxaùl, which does not attain any great elevation. Farther westward the range is woodless, and gradually descends. Its heights have not been measured.

The Ketch-kene Kara-taù terminates between the Kumyr-Tas River and the Turlan Pass. At its highest part the Kara-taù is a single range; but to the west, from Turkestan, another range of not very high mountains stretches along the Kara-taù, parallel

to the main range, and on its south side only. The northern declivity falls precipitately towards the steppe.

The steppe between the Kara-taù and the Syr-Daria is capable of cultivation only along the small streams, where there are fields already cultivated. The further to the west that this steppe extends the lower it inclines, and the more saline and barren it becomes. The best places to the north of the Arys are by the Arys-tandy Rivulet, between the Chilik and Turkestan; and to the south from the Turlan Pass. Further westward the streams running from the Kara-taù are shorter and shorter, till at last they are only springs. All these streams lose themselves in the steppe before reaching the Syr-Daria. Between them and the Syr-Daria to the west of Yany-kurgan is a dense growth of saxaül, which at Suzak, on the northern side of the Kara-taù, extends much further east to the base of the mountains; but beyond that, eastward, it again becomes scanty.

Between Cholak and Aulié-ata, the Ketch-kene Kara-taù descends towards the steppe in wide and rather steep gradients furrowed by dry gulleys. These gradients are arid and barren, and consist of sedimentary formations. At their feet are a great number of salines; and there are also salt lakes. The rivulets issuing from the Ketch-kene Kara-taù are few, and flow only in the gulleys of the outlying hills of drift, losing themselves almost at their very outlet into the steppe. At Cholak and Suzak only, are there any means of irrigation. At these places there are cultivated fields and gardens; there is brushwood, such as willow, growing by the rivers; hawthorn occasionally in the steppe, saxaül and "djuzgun" grow at some distance from the feet of the mountains, in the sands by the lower courses of the Talas and Chu.

The neighbourhood of Biliu-kul is likewise saline; on the salines *Salicornia herbacea* is found; but the lake itself is almost fresh, though salt is cast up along its level banks, which in the spring are inundated by its waters. The lake itself is thickly fringed with reeds, affording shelter to innumerable wild-boars, and occasionally to tigers. There are large quantities of wild-geese, herons, snipe and pheasants; but very few wild-ducks.

Biliu-kul is 1500 feet above the level of the sea; its length is about 20 versts, its breadth from north-west to south-east is 8 versts, and its form that of a parallelogram. Besides the Asa, Biliu-kul receives a great many tributaries which are dried up during the summer. The Asa runs through the lake, and finally empties itself into Ak-kul, still flowing between wide and flat hills formed of deposits from the Kara-taù. The whole length of the course of the Asa is about 120 versts; its only affluent after its issue from the

Urtak-taù defile, but that a very considerable one, is the Tera. Thus the Asa receives all the waters from the northern decline of the Urtak-taù, between the sources of the river Karabura, disemboguing into the Talas; and the sources of the Arys, flowing from a region of 45 versts in extent, of perpetual snow. But the waters being almost wholly derived from the melting snows, they subside in a very great measure towards the end of summer. The Arys is scarcely at all fed by perpetual snows, but almost entirely by those that fall during the winter, spring, and autumn; the water from which, after a thaw, being absorbed by the limestone, gives birth to countless numbers of perennial springs. The Arys has a far larger volume of water than the Asa, and sustains it in summer much more than the latter.

The Arys draws its principal tributaries also from the western Urtak-taù, chiefly from the range that separates itself from the Urtak-taù at the sources of the Mashat, within 30 versts to the s.s.w. of the place called Yaski-chù. This range proceeds in a south-westerly direction, terminating within 15 versts of the Chirchik, and 30 versts w.n.w. of Tashkend. From this range, within 20 versts south-west of the sources of the Mashat, flows likewise the Badam, the largest of the affluents of the Arys. Its course is 90 to 100 versts in length, if not more; its sources are believed to lie within 70 versts of Chemkend, which is a considerable exaggeration; and its embouchure is 45 versts from Chemkend; of the latter portion a survey has been made. In this calculation, the length of the valley is of course reckoned; not the course of the stream, which at every hundred fathoms makes several abrupt turns. At the sources of the Badam, striking off from the last-named range, directly to the west, is a not very high, but a precipitous, narrow, and lengthy spur, 45 versts in length, called the Kazy-kurt-ata; giving rise to the left tributaries of the Badam. Leaving the main range, it gradually descends, but again rises at its extremity, and ends in a steep double-crested peak, standing twice as high above the plain as the portion of the range immediately contiguous. Instead of rain, snow begins in September to descend upon the summit, and falls till November; it does not, however, lie upon it continuously, but frequently disappears altogether, thereby showing that the elevation is about 7000 feet. It is this elevation alone, and consequently not the range in which it terminates, that is known to the natives by the appellation of "Kazy-kurt-ata;" * which

* The solitary height of Kazy-kurt-ata, is considered, by the people of Chemkend and Sairam and the neighbouring Kirghizes, to be the identical mountain upon which Noah's ark rested.

appellation Humboldt, calling it in an erroneous transcript "Kozy-kurt," assigned to the imaginary meridional range—the continuation of the Bolor between the Syr-Daria and the sources of the Arys. Even on our latest maps up to the year 1864, this name is applied not only to the meridional range, but to the whole Urtak-taù from Susamir to its extreme western end; while actually, this is the name of a single mountain situated directly south of Chemkend. But the whole of the Urtak-taù, however, as I have already observed in allusion to the sources of the Chirchik, is not one long range; it consists of a number of short ones, stretching now north-east, south-west, now south-east, north-west, now east, west; and composing together an unbroken, though tortuous, water-limit, of which the Kazy-kurt was accounted the actual termination. But owing to the unbroken continuation of the mountain-ridge in one direction, from the very sources of the Kara-bura, the real western extremity of the Urtak-taù should be reckoned to be the range between the Arys* and the Mashat, as above described. As regards the Kazy-kurt; it separates the sources of the Badam, and consequently those of the Arys, from the upper course of the Keles, which probably falls into the Chirchik between Tashkend and the Syr-Daria.† It is certain that the Keles communicates with the Chilik by means of canals cut for the purpose of irrigating Tashkend and its neighbourhood. From the mountain properly called Kazy-kurt-ata, there is a flat elevation separating the waters of the Arys and Chirchik; having a lofty peak standing alone, to the south-west of Chemkend, and to the south-east of the junction of the Badam with the Arys.

As regards the range stretching from the source of the Mashat to the south-west towards the Chirchik, it separates the Keles from a considerable mountain stream; between which and the Chirchik there is another snowy range.

My geological map was drawn according to the views obtained from the valleys of the Chirchik, Keles, Badam, Mashat and Arys, from the neighbourhoods of Chemkend and Tashkend; but only two ranges were drawn correctly; one to the right of the Chatkal (Upper Chirchik), and the other to the left of the Keles; they are both parallel to one another. There may be between them some other parallel ranges and several mountain streams of considerable dimensions, of which at present only the one nearest to the Chirchik is known to me.

* The more so, as its water-limit is of more importance than that of the Kazy-kurt, *i. e.* that lying between the Syr-Daria and the steppe rivers. At the sources of the Arys it passes from the Urtak-taù to the Kulan Range.

† Up to the year 1864 the Keles was shown on all maps to disembody immediately into the Syr-Daria.

The steppes at the bases of the mountains just described, south of the Arys, are, so far as I could observe, all covered with an equally fertile soil, judging from their spontaneous vegetable productions. These consist of various thickly growing grasses of *Alhagi camelorum*, and many other varieties, chiefly of siliquose and many-coloured plants. There is no brushwood whatever. Cultivation on these steppes differs very greatly; as agriculture depends upon the local conditions respecting irrigation, as is the case in the whole district under consideration. It is more energetically pursued among the denser population between the rivers Arys, Badam and Mashat, and the mountains in which the two last rise; besides which, for purposes of irrigation, there are numerous other small streams between the Mashat and the Badam, fed from springs, and issuing from the hollows between the foot of the mountains and the Arys; such, for instance, as the Biuriudjar, a right affluent of the Badam, and the copious streams in these hollows, as, for instance, close to Chemkend, where from a single basin of spring-water there issues a stream in itself sufficient to irrigate all the gardens of the town, and also to work several mills in the neighbourhood.

There is again a fair system of irrigation, and accordingly a settled population, between the Badam and its left tributary the Sasyk, issuing from the Kazy-kurt. These districts about the Arys, Badam and Mashat, form the granary of the former Khanat of Tashkend; and from hence over and above the quantity retained for local requirements, supplies of corn are exported to Aulié-ata, Turkestan and Tashkend. In addition to what has been stated above as being grown in the valley of the Arys, cotton and sesamum are cultivated along the Badam and Mashat. Here, in the vicinity of Mankend, is the northern limit of cotton; but it can be grown even farther north, to judge from the experiments made by Mr. Kuznetsof at Almaty. Even at Gurief, at the mouth of the Ural, the seeds of cotton (though of a grassy kind, as it is generally in these parts) that were sown, grew up very well. But at Almaty, the capsules are smaller, and the stalk is shorter than at Chemkend. The Chemkend cotton, in its turn, is inferior in the size of its capsules, and the length of its stalk to that of Tashkend; which again is inferior to that of Bokhara. The Gurief cotton is, however, so bad, that its price in the market cannot repay the cost of cultivation. Even a grassy cotton requires a prolonged summer. At Chemkend it flowers in July and undeveloped capsules appear even then; but these ripen at the end of September, or more generally in October. At Tashkend, in the beginning of October I saw in one and the same field mature and unripe

capsules, and even flowers. The cotton here outlived the frost of the (15th) 27th September, which killed the tendrils of the melons and water-melons. At Chemkend, however, one-third of the cotton perished in October before the capsules ripened; and at Almaty, probably one-half is destroyed by the frost; at Gurief, a still larger proportion. At Mankend, near Chemkend, I saw the gathered capsules; they are gradually picked as they arrive at maturity—an operation facilitated by the sub-division of the fields for the purpose of irrigation into squares of $1\frac{1}{2}$ to 2 fathoms, separated by earth-mounds. Only the faded capsules are picked; and they are then left in the sun to burst.

These observations may serve toward the determination of the question of the acclimatization of grassy cotton in the south of Russia. I could not at the time have pursued the subject further in detail, without neglecting the real objects of my mission.

In the town-gardens between the Arys and the Badam, are grown grapes, peaches, apricots (ouriuk) and garden "djida."* Walnut and mulberry-trees also flourish; but I did not hear that the inhabitants of these parts attend to the rearing of the silk-worm, like the settled population of Kokan to the south of the Syr-Daria is known to do. It is therefore to be inferred that if the silkworm is reared here at all, it is not done so very generally.

The outlines of the steppe south of the Arys, and its deep gulleys, have already been dwelt upon. It may be said in addition respecting these gulleys, that they are frequently of great width, *i.e.*, of 200 or 300 fathoms, and even of a verst broad. We may conclude from the fact of irrigation canals running from the gulleys, that from the Arys the steppe descends, not in one gradual slope, but by gradients. The rivers flow in deep valleys; and the affluents of the Arys are deeper than that river itself. At Mashat, both banks are high; in some places there are even overhanging cliffs standing 500 feet above the river; as for example, by the road from Aulié-ata to Chemkend. At Badam, the left margin of the valley is rugged and precipitous, but not higher than 100 feet. From this, towards the water-line from the Kazy-kurt, there is a very considerable slope extending 20 versts, with several abrupt gulleys. The chief valley here is that of the Sasyk, which river flows from the Kazy-kurt to the Badam, but reaches the latter only in spring. Both sides of the valley of

* *Eleagnus hortensis*, bearing a fruit of the size of the olive, of a yellowish-red colour. The wild "djida" (*Eleagnus angustifolia*) bears a smaller fruit, of a greyish-green colour even when ripe.

the Arys, as above stated, are abrupt, though of no great height.

The localities to the south of the Badam, I generally surveyed only from the road leading from Chemkend to Tashkend, in the beginning of October (O. S.). Beyond the Sasyk, this road trends into the eastern outlying rocky mountains of the Kazy-kurt; and leads out of them again along the banks of the affluent of the Keles. Here the steppe is rough and wavy; it rises also in sloping hills, which fall, however, rather precipitously towards the Keles and its affluents. The Keles is 6 to 7 fathoms in breadth, and is shallow, being rarely deeper than $1\frac{1}{2}$ foot; and at the utmost is $4\frac{1}{2}$ feet deep in its occasional pools. Its banks in the valley are abrupt and very low, viz., about 3 feet in height. The current is moderately rapid; the bed consists of either mud or sand alternately. The waters of the Keles occasionally approaching the margin of the valley, sometimes lave the bases of abrupt crags about 10 fathoms in height, generally of sedimentary origin, and partly composed of the denudations of red sandstone mentioned above. The valley of the Keles is 2 versts wide, and displays numerous corn-fields. There is not so much lucern grown in this valley; and as to cotton, I saw none at all. The soil is oozy, as on the Arys; but less loamy; there is also less irrigation, and the crops are inferior. Besides those in the valley of the Keles, there are fields also on its left bank which is considerably more depressed than its right, and is therefore capable of irrigation by means of canals cut from the river higher up. The steppe is, speaking generally, covered with a fertile soil, and by a tolerably dense growth of herbaceous plants; but towards Tashkend it is less productive, owing to the predominant element of red clay.

Tashkend is built in the broad valley of the Chirchik, which is about 20 versts in breadth; its northern side is not more than 25 to 30 fathoms above the bottom of the valley, but this valley is very steep. Tashkend is irrigated by means of canals cut from the Chirchik at Fort Niaz-bek.

The Chirchik flows within 8 versts of the town, which stands near the northern edge of the valley. I saw Tashkend from the outside, though from no great distance. The nearest elevation (of which there are many in the broad valley, the whole of its surface being uneven), from whence I could overlook the interior of the town, stands at a distance of 100 fathoms from it. The town has the appearance of a large forest, with here and there a mud wall, and a flat mud roof visible amid the foliage of the trees. It is filled with gardens which screen the small houses from sight. There are two large buildings to be seen, and there are no monuments whatever.

The Mesjids, of which there are said to be a great number, according to some 50, to others 500, and even 2000, cannot at a distance be distinguished from the houses, and they do not rise above the garden poplars.

The town is enclosed by a mud wall, with barbets, surrounded by a deep trench, in some places filled with water from the irrigation canal, in some parts dry, as it is dug in uneven ground. Near the southern side of this enclosure, is a citadel, which at sight may be said to be 300 fathoms in length, and which is surrounded by another wall half-dilapidated, on the side of the town enclosure, which is here consequently stronger, and is kept in better repair; and the strong walls of the citadel overlooking the interior of the town are likewise carried on to the town enclosure. The space within the town walls is about equal to that of Moscow. The results of a survey show it to be about 12 versts in length from east to west, and 7 versts in breadth from north to south. Allowing, as I was assured was the case in 1858, that half the houses are uninhabited, there must be no less than 100,000 inhabitants. But there are many houses with gardens outside the walls of Tashkend; and those nearest the town are as close together as the courts with their houses and gardens are within the town itself. They form regular suburban villages, as, for instance, the one that lines the Niazbek road,* extending 4 versts; and the one on the Kokan road, stretching 5 versts.

Between these gardens and villas are fields of lucern and corn, but chiefly of cotton, sesame, and zedoary. I could see no madder; and even of the cultivation of the zedoary I speak only from accounts received from enquiry.

About Tashkend there is more cotton than anything else cultivated. Of cereals, rice is extensively grown; but far too little wheat for the requirements of the whole town. The latter is brought from the Keles, especially from the vicinity of Chemkend. The Tashkendians pay more attention to saleable products for exportation, and to their own manufactures. Mulberry-trees are common, and vines are abundant; as well as all those fruit-trees that occur in the towns between the Arys and Kazy-kurt; to these must, however, be added the fig-tree, which is not to be found in the latter places. It probably finds its most northern limit in the Trans-Chu region, in the neighbourhood of Tashkend, for at the beginning of October (O.S.) the fruit was not quite ripe, although then extremely sweet.

A few words concerning the towns of Kokan may here be not

* Niaz-bek is a fort on the Chirchik, within 15 versts south-east of Tashkend, commanding the canals which are conducted towards it from out of the Chirchik.

inappropriate. They differ from each other almost only in size, and perhaps also in the number of their gardens. To the north of the Arys, there are not so many gardens in the interior of the towns as in their outskirts; as, for example, at Aulié-ata and Azret.* In the last-named place there is hardly a single garden; they are all outside; and even those that I saw in 1858, under the outer side of the wall, have since been dug up. On the other hand, all the towns to the south of the Arys present the appearance of having large gardens; and their unsightly buildings are hid among the trees. These buildings require no description; they are all of mud, all look eastwards, are one-storied, and flat-roofed, and are without windows towards the streets. I will only remark that there is no communication between the rooms, which open upon the courtyard by several doors. Before the doors of each house is a common shed, supported by posts, beneath which the inmates are generally found sitting, if not reclining upon the embankment facing the street. The doors generally exhibit carved devices; the windows are trellised with wood, but are without glass; in the winter they are pasted up with oiled-paper; one aperture, where there is no regular stove, being left open for the escape of the smoke from the fire burning upon the mud floor. The stove is, properly speaking, a four-cornered chimney, with a wide opening at the bottom. When a fire is made in it, the least puff of wind fills the room with smoke. There are many recesses in the walls, which serve for cupboards.

I need not enumerate all these towns, as they are marked on good maps of Turkestan. Something might be said of their bazaars, their trade, and their monuments.† Of the latter, there are only two in all the towns put together, viz., the Holy Mesjids in Aulié-ata and at Azret. The last place I did not visit in 1858.

This article is already drawn out to a great length, I must therefore conclude the topographical portion of it; and, in conformity with its physico-geographical character, I shall proceed to give the hearsay statements I obtained concerning the River Chirchik.

This river issues from the mountain 10 versts above Niaz-bek, through a very narrow and impassable defile. The road from Tashkend to its sources does not pass through this defile,

* Improperly called Turkestan, the ancient name of the countries between the Chu and Syr-Daria (Western Turkestan), and along the River Tarim (Eastern Chinese Turkestan).

† Official statistics relative to the towns of the Turkestan province are being now compiled; but, when I was there, those relative to Aulié-ata were alone completed.

but runs across the range, showing that the river breaks through the clefts of the mountain-range that bars the upper portion of its valley.

In the Tashkend valley the Chirchik flows between steep banks; and, although a portion of its waters is diverted into irrigation canals, it is nowhere fordable. To the south of Tashkend the river forms swamps, which are partially sown with rice. Lower down, there are again lagoons, through which the river passes in a single stream, 120 feet wide without any fords; and so disembogues into the Syr-Daria. The course of the Chirchik, after issuing from the lagoons, is not more than 10 versts, if so much; but it flows rapidly.

In consequence of these lagoons, the Chirchik is navigable only below them, and therefore for a shorter extent than the Arys, which is navigable for steamers for at least 30 versts if not more, from its mouth upwards. Yet the Chirchik is a more copious river than the Arys; and if a canal were to be cut through its flooded parts, overgrown with reeds, the rapidity of the current would impede navigation higher up, if only to Tashkend. I judge of the rapidity of this stream from the principal canal cut from it; the water in which, even at Tashkend, rushes along like a mountain-torrent; and, since the canal was constructed in very remote times, it has deepened its hard bed of limestone and sandstone.

Between the Lower Chirchik and the Syr-Daria there is another island, visible from the neighbourhood of Tashkend, not very elevated, but detached and intersected by valleys, which are crescent-shaped and radiate from its centre. Between this and the nearest spurs of the Western Thian-Shan, which lie south of the issue of the Chirchik through the defile, is a saddle-shaped opening, through which passes the road from Tashkend to Kokan and Namangan. Another road from Tashkend to Kokan and Khodjend, passes round this highland from the west, along the Syr-Daria. The mountain valleys between these roads are occupied by the Kurama tribe, belonging, according to some accounts, to the Uzbek, and, according to others, and to the result of my own inquiries, to the Kirghiz race.

Let us now embrace, in a brief physico-geographical summary of the Trans-Chu region, all the particulars concerning it which have just been obtained, so that the reader may himself see how far these observations serve to correct the too numerous misconceptions relative to Central Asia, and especially relative to the mountainous country between the Chu and the Western

Himalayas, or Tsun-lin, in the recognised wide Chinese * sense of that appellation.

The first of these misconceptions arises in regard to the connexion of the Kara-taù with the Bolor. From lat. 34° to 45° N., between long. 71° and 69° E. from Paris, Humboldt supposes there to exist one unbroken chain, the Bolor, intersected by the Syr-Daria at about lat. $41^{\circ} 40'$, and long. $69\frac{1}{2}^{\circ}$; and that further south, at about lat. $40^{\circ} 20'$, this range is intersected by the Thian-Shan. Between the Thian-Shan and the Hindookush alone, it is called the Bolor; to the north of the Syr-Daria, it bears the name of "*Kozy-urt*." The Thian-Shan not only intersects this range to the south of the Syr-Daria, but also connects itself with it in the north by its spurs. From the south bank of the Issyk-kul to the point of its intersection with the Bolor, the Thian-Shan proceeds in a south-westerly direction between lat. 42° and 40° N., and is called the Gakshal-taù and Terek-taù; westwards of that intersection it is known under the appellation of the Ak-taù or Asfera, and stretches away directly to the west along the parallel.

Along the Terek-taù, towards W.N.W., run several mountain-chains, of which little is known; on Humboldt's map these are, consequently, traced indistinctly, without any names being given to them, with the exception of the extreme northern one, which is called the Burul, and of the western chain, called the Khubahoi, through which the Talas forces its way. This chain stretches in the form of an arc, first towards north-west, then, beyond the issue the Talas, to the south-west. All these chains abut on the meridional Kazy-kurt, from which, however, diverge also the western spurs of the Kendyr-taù, Ala-taù and Kara-taù. The latter is the most northerly of all, being in lat. 45° N.

This construction Humboldt bases upon the evidence of Son-Yun and Huen-Tszan, and upon the continuation of the Tsun-lin (*i.e.*, according to him the Bolor, supposing the other term to be the name of one mountain erroneously applied to a whole range), to the Myn-bulak district.

I may add, that from the pass over the Kara-taù at Cholak, and up to the very Syr-Daria in the vicinity of Kokan, mountains are continually visible in the distance on the left side of the road; extremities of a mountain-range which are not meridional are also seen.

It is only these extremities of mountain-ranges, and their more easterly intersection by the road from Aulié-ata to

* Humboldt, as we know, applies the name of Tsun-lin only to an inferior portion of this extent, viz., to the convergence of the Kuen-lun with the Bolor, the limit of which he defines to be a mountain-knot south of Sary-kul (Sea of Victoria), at the sources of the Yarkend-Daria and the Amu-Daria.

Namangan, that are taken into account in the latest maps, not the continuous ranges visible along the road from Cholak to Kokan. Humboldt's meridional range between the Chu and Syr-Daria therefore disappears from these maps; and there remain only the mountains running w.n.w from the Terek-taù. Thus, on Kiepert's map of Turan to Ritter's *Geography of Asia*, to indicate the absence of information, only detached fragments of ranges are traced at the points of intersection by military routes; on the strength of which this portion of the map was constructed.

On the maps constructed on the basis of investigations made by the Department of the General Staff of Western Siberia, these fragments are connected into long parallel ranges; as, for example, on the first map of Kokan appended to the *Journal of the Geographical Society*, and on the 4-sheet map of Central Asia.

In his article on the Bolor, Mr. Veniukof also rejects the northern prolongation of the Bolor beyond the Syr-Daria,* and does not trace it on his map of Kokan,† which is nearer the truth than any of those previously published, even subsequently to 1864, inasmuch as it indicated the prevailing direction of the mountain-ranges between the Chu and the Syr-Daria, to be from east to west, and not from south-east to north-west, as traced on other maps;‡ and also as it shows their connexion with each other by means of short meridional chains in many places and under various latitudes. But in the western portion, to the west of the meridian of Aulié-ata, the direction of the mountains is only N.E., S.E., w.N.W. And yet it may be seen, from my notes of travel given above, that Humboldt is half correct. For, firstly, the Kulan Range occurs exactly in a line with another range of the Bolor system, which separates the Kara-kul table-land from that of the Rian-kul, besides intersecting the Ak-taù, and then continuing toward the north to the Syr-Daria. The direction of these ranges is s.s.e., n.n.w. Secondly, there is a range of mountains extending between the Syr-Daria and the Kulan ranges, in the direction

* 'Memoirs of the Imperial Russian Geographical Society, 1861,' Book II. page 160 :—"It is hardly possible to do otherwise than to detach the Kazy-kurt and Boroldai from the system of the Bolor, and apply them to the offshoots of the Thian-Shan." This is true as regards the Kazy-kurt; but the Boroldai belongs to the system of the Kara-taù, the relation of which to the Thian-Shan and Bolor I will shortly explain.

† 'Memoirs of the Imperial Russian Geographical Society,' Book I., 1862.

‡ For instance, on the maps just alluded to, viz., Kiepert's, the 4-sheet map of Central Asia, published by the Geographical Society; Semenof's map in Petermann's 'Mittheilungen,' 18; on the map of the Orenburg region and southern portions of Central Asia, on the scale of 100 versts to the inch; on the map of Western Siberia, scale 50 versts to the inch.

of south-east, south-west, and nearing the meridional range. This is the Karjanyntaù Range, running along the Keles between that river and the Chirchik. So that one who has not been an eye-witness, but has availed himself of indefinite Asiatic itineraries alone, may easily take this range to be a connecting link between the Kulan and the Bolor. But Humboldt must, of course, have been unaware that the direction of the Karjanyntaù, with that of the Kulan Range, forms nearly a right angle.*

The more serious inaccuracy in his geographical deductions is the imaginary consecutiveness of the Northern Bolor, and even of the whole of that range generally. Arguing from the data we at present possess respecting the Central Asiatic mountain region (*i.e.*, the Tsun-lin of the ancient Chinese), the Bolor, in the sense of a distinct range, does not exist; and the mountains so called ought to be classed with the Himalayan system.

Each system consists of several ranges, following various directions, but all connected together. These ranges are distinguished by the directions in which they proceed, or, rather, by the direction in which their strata extend. The mountain chains appear to me, however, to be partly an artificial, schematic arrangement, not quite in keeping with nature. Properly, those places on the map should be marked where there are actual ranges, that is, where there are upheaved strata preserving a uniform extension for a great distance; and also those places where the lines of the extension of these uplifted, contorted, and broken strata frequently cross each other, and where, consequently, many conterminous elevations of inconsiderable magnitudes, as regards their horizontal extension, unite in one vast contiguous mass of highlands, reft, however, by the narrow chasms of river valleys. Such an elevation the Tsun-lin appears to me to be, as it is formed by the intersection of the Thian-Shan system with elevations from the Himalayas. It would be more correct to represent it without any ridges, and to shade it more or less darkly, according to its height, with the river valleys, and with lines marking the direction and extent of the various strata; but for such a delineation, which would I believe be the more regular one, the geological observations have not been sufficiently numerous. No minute surveys have ever been made of the mountains to the south and south-west of the Chu.

I. Of the Western Thian-Shan, I am geologically acquainted with three ranges: the Western-Trans-Ili-Alataù, at the

* Among the 'Memoirs of the Imperial Geographical Society, 1862,' Book III., is a chart without any text, on which Mr. Veniukof's system of the Trans-Chui Range is connected with that of Humboldt.

Kastek, the Kirghiznin-Alataù, and the Urtak-taù. From the points at which I saw them, neither of them presented the appearance of independent ranges; that is, of ranges in which upheaved sedimentary strata occur on both sides of the crystalline axis which has upraised them. On the northern declivity of the Kirghiznin-Alataù sedimentary strata preponderate; and on the southern slope crystalline formations, alternating, however, with sedimentary. The same may be said of the western portion of the Kungé-Alataù, between Tokmak and Kastek. In both these ranges crystalline formations, granites and syenites, cropping up at the southernmost bases, connect each of these chains with the next towards the south, as is more minutely described above. The connexion of the Trans-Ili-Alataù with the Kirghiznin-Alataù, I saw at Tokmak and on the Issyk-ata; the connexion of the Kirghiznin-Alataù with the Urtak-taù I saw at the Talas and Kara-bura; and the connexion of the Urtak-taù with the Namangan Range, near the mouth of the Kara-kyspak, opening into the Chatkal. The connexion is, as we have seen, exemplified by the sedimentary strata of the range; for example, some of these falling away from a given range, and towards the nearest crystalline formation.

The upheaved strata were observed to extend principally in three directions, viz. :—

1st, N.E., S.W., to which also refer directions to E.N.E., W.S.W., and N.N.E., S.S.W. The latter direction occurs only at one place, the confluence of the sources of the Talas; the two first in the southern declivity of the Kirghiznin-Alataù, in the Cha-archa Range, which geologically forms a part of it; and in both of the slopes of the Urtak-taù. In these directions metamorphic schist is upheaved, with intermediate strata of dark limestone and sandstone; in which, likewise, no organic remains were discovered.

2nd, E., W., and E.S.E., W.N.W., sedimentary strata on the northern slope of the Kirghiznin-Alataù; crystalline formations on both of its ridges, and along the eastern summit of the Kara-kyspak. In this direction there is an upheaval of sandstone, exhibiting on the River Merké organic remains, chiefly of the *Spirifer*, and occasionally *Productus*.

3rd, N.W., S.E., the least frequent, and only by the sides. Such, in W. 30° N., E. 30° S., is the direction of the sandstone with rock-salt, in the northern outlying mountains of the Kirghiznin-Alataù, between Ala-medyr and Ala-archa; and of the limestone in the western extremity of the Urtak-taù, between the Arys and the Mashat. This extension in the Thian-Shan is generally hardly distinguishable from the fore-

going, although here and there are traces of an independent upheaval.

It appears to me, from the nature of the upheaved formations, that the first of these three principal directions, viz., N.E., S.W., and the direction nearest to it, is the most ancient. The absence of organic remains does not, however, allow of the accurate determination of the geological period. I nowhere found limestones with spirifers resting on metamorphic and other alternating formations; but the relative extension of the strata in the Urtak-taù and the Kirghiznin-Alataù, and its general direction, seem to me to be favourable to the opinion that the upheavals north-east, south-west, happened earlier than those east, west, and E.S.E., W.N.W. The latter either abut on the extremities of the first, as on the northern slope of the Kirghiznin-Alataù, or intersect them, as on the water-parting of the Urtak-taù. Both of these systems of upheaval is illustrated by the valleys, previously clefts, parallel with and perpendicular to the upheavals. For instance, in a direction north-east, south-west, lies the valley of the upper Chirchik; in a line perpendicular to this direction are the valleys of the affluents of that river. In a direction east, west, lie the valley of the Talas, and the valleys of the affluents of the Kara-bura and Kara-kyspak; the valleys of the two last lie perpendicularly to that of the first-named river. The valleys of the Talas and Chirchik have been widened, but the others have preserved their original character of clefts.

The limestone with spirifers on the River Merké, upheaved in a direction from east to west, seemed to me to belong to the mountain-limestone formation (calcareous); but it may be Devonian. In Russia, however (for example, in the province of Tula), these two formations are not distinctly separated, but are intermixed, both lithologically and as respects the common *habitus* of their fossils—the difference is hardly perceptible to the uninitiated, except that there is one striking *Productus giganteus* of the mountain limestone, which does not exist in the neighbouring Devonian limestone. Neither did I find this fossil on the Merké, where there are small specimens of the *Productus*. Evidence of an independent upheaval of such strata as reddish sandstone and conglomerate, extending W. 30° N. by E. 30° S., is found, for example, in the outlying hills of the Kirghiznin-Alataù, on the Ouriandas, and between the Alamedyn and Issyk-ata, where these strata dip towards the limestone; but on the Ouriandas it is apparent that these sandstone strata are bent and undulating. There is a denudation of veins of granite in the bottom of the valley, at a hill formed of strata of this sandstone.

On the River Merké the strata of sandstone and limestone at their point of contact are upheaved perpendicularly, and some are entirely overturned. This dislocation is not the same on both sides of the cleft; on the right or eastern side the sandstone extends further to the south, which indicates that the upheaval was very limited in extent, in a direction N. 60° W., S. 60° E., and that it occurred after the deposit of sandstone, and certainly not earlier than the Permian period.

This is confirmed by the coal-beds in the Kara-taù, which lie in a direction from east to west, and by the coal-seams of Kuldja, between the mountain-ranges stretching in a similar direction, east and west, along both sides of the valley of the River Ili.

Generally speaking, as has been already observed, the direction from east to west passes imperceptibly enough into a direction of south-east, north-west, and connects, by means of a complete series of intermediate rhumbs, even the perpendicular opposing lines of elevation, north-east, south-west, and south-east, north-west.

There are also, in the Thian-Shan system, traces of short ridges almost meridional. I saw one of the kind as a snowy range in the distance, running in the direction of N.N.E., W.S.W., at the sources of the Chirchik. I had not the opportunity of exploring it geologically; but the strata at the confluence of the two sources of the Talas, where syenites and diorites alternate with the limestone and micaceous and argillaceous schists, have a similar extension, only not along the line of the range at the upper source of the Chirchik, but farther east. Consequently, such almost meridional ranges may, with some degree of probability, be referred to the period of the most remote upheavals north-east, south-west.

Corresponding with the direction of the strata along the Kara-bura and Kara-kyspak is the direction of the ranges striking off from the Urtak-taù to the south, parallel with the Chirchik. This direction bears E. 40° N., W. 40° S.

The Terek-taù, an offshoot of the Thian-Shan, between the sources of the Naryn and Kashgar-Daria, has generally the same direction; but here there are a great number of minor ranges running in other directions.

The northern range of the Kirghiznin-Alataù has a direction east, west, and E.S.E., W.N.W., the same as that of several short mountain chains of the southern range. Lateral valleys generally separate the range into the northern long range east to west, and into many southern short ranges, running in two directions, north-east, south-west, and south-east, north-west. Abutting on the northern range, at acute angles, the first-named direction predominates, and both are seen at the Upper Kara-kyspak.

East to west is also the general direction of the Urtak-taù; but the water-parting itself is tortuous. Short ranges, with a direction E.S.E., W.N.W., and S.E., N.W., intersect the spaces between the more extended parallel chains north-east, south-west, and also invariably at the north-east extremities of the latter; so that across all these short intersecting ranges a direct line may be drawn east to west, which will be obviously the *central* direction of the range; while it will give an erroneous idea of the Urtak-taù, if drawn to characterise its configuration, without reference to the short mountain chains of which it is principally composed.

It may be seen by the map that the same directions exist in the western portion of the Thian-Shan, on the Susamir, at Sonkul, and at the upper course of the Chu River, which I have not visited. They also characterize generally the portion of the Thian-Shan system to the west of the meridian of Kute-maldy. This is a system of intersectional ranges; but, at the same time, in the Issyk-kul portion of the Thian-Shan and eastwards the predominant ranges are parallel, bearing E.N.E., W.S.W.

But there are intersectional ranges, having corresponding directions south-east, north-west, and north-east, south-west, even further to the south, in the upper course of the Oxus, as demonstrated in Veniukof's map.* All of this mountain region may, therefore, be considered as forming a whole: a fact observed, though not explained, by the Buddhist missionaries Son-Yun and Huen-Tszan. The determination by the latter of the boundaries of the Tsun-lin I am, from my personal observation, bound unconditionally to confirm.

This mountain region is divisible into two portions by a line drawn through lakes Rian-kul and Kara-kul. In both portions the directions of the intersectional ranges are alike, only in the northern half the preponderating direction is north-east, south-west, and in the southern south-east, north-west;† consequently,

* 'Bulletin of Russian Geographical Society, 1861-2.'

† This southern portion is then the Bolor in the strict sense, as it is accepted, for instance, by Kiepert. That it belongs to the Himalayan system has been stated by Veniukof ('Bulletin of Russian Geographical Society, 1861,' page 164). Apparently that marked distinction between the systems of the Bolor, Kuen-lun, Himalayas and Hindoo-kush, which is pointed out by Humboldt, does not actually exist. "The three first appear merged, as it were, into one common elevation, the axis of which stretches from north-west to south-east." According to the measurements of Schlagintweit ('Voyage,' Part II., Hypsometry), the highest range in this elevation is the central one of the Kara-korum, the Himalayas and the Kuen-Lun; the marginal ranges of the general elevation are lower, but have a direction from west to east. At Nepal detached peaks of the Himalayas do rise above the Kara-korum, though the Himalayan Range does not exceed the latter in its general height. As far as the sources of the Indus, the Himalayan system, *i. e.* the elevations on both sides of the Kara-korum, presents, according to Cunning-

the northern portion is the Thian-Shan, and the southern the Himalayas.

Judging by the constant relations between the directions of ranges, and the general extension of their strata which I observed, one may form a general opinion as to the geological history of the whole of the Tsun-lin; notwithstanding that only a very small part of it, and that only in the Thian-Shan portion, has been geologically surveyed. This mountain district has been formed by an unintermitting and closely contiguous series of upheavals, each of which occupied no long period of time; indeed, many of these elevations running in a similar direction, were geologically contemporaneous, though, of course, they must not be considered as the result of a sudden simultaneous upheaval acting in different places. On the contrary, the process of upheaval was general, gradual and unremitting, although not equally so throughout the whole extent; as there were short and slowly-alternating directions of maximum pressure, and several of these during a given time. The unremitting nature of the process is demonstrated by the great variety of directions between the two marginal ones, intersecting each other at acute angles open to the north and south, N.E.E., S.S.W., and S.S.E., N.N.W.; the intermediate directions between these two filling the obtuse angles opening towards the east and west. It may be supposed that by an uninterrupted process of upheaval the present Tsun-lin Mountains at first formed an archipelago of islands, and that these islands afterwards became joined together. As, however, their very traces are now hardly discernible, the bottom of the original strait probably became subsequently elevated above the original islands. But, judging from the distribution of the geological formations along the Kara-archa, Kara-bura and Karakyspak, it is probable that an unbroken continent was here formed by upheavals, north-east, south-west, prior to the deposit of limestone at Merké. Considerable upheavals occurred, after the deposit of limestone, in directions between east, west, and south-west, north-west, when the Tsun-lin attained its present elevations, and perhaps greater than exist at present; and

ham's map ('Ladak, Physical,' &c.) two different directions of mountain-chains, the principal ones being north-western and south-eastern ranges, lying north-east and south-west, which directions are similar to those in the Bolor Mountains. In the latter the north-western direction approaches nearer to the meridional than in the Himalayas; but on Kiepert's map, for example, this difference is far less considerable than on Veniukof's; yet the actual direction, *i.e.* its angle with the meridian, is not even determined: all that is known is that it lies north-west, south-east. Therefore the Bolor is not a distinct meridional range, but merely a north-western continuation of the Himalayas, or, more correctly, of the Himalayan branch of the Tsun-lin, which is a gigantic convexity, connecting, by means of gradual transitions, the system of the Thian-Shan with that of the Himalayas.

allowance should be made for the action of the wind on the débris, and subsequently of the water. Then came the formation of the gulfs, the present wide valleys of the Talas, of Fergana at the Jaxartes, and that of Badakhshan at the upper course of the Oxus, as shewn by their directions from E.S.E. to W.N.W.; but their beds were raised above the level of the ancient sea, probably before the formation of the Permian strata, of which there are no denudations, at least in the valley of the Talas. The upheaval of the Permian formations on the northern and north-western limits of the Tsun-lin is inconsiderable, and denotes the termination of its general uplifting. There were still local upheavals towards east, west, and south-east, north-west, which at the northern base formed a long line of outlying mountains, and produced small ridges at the western base.

The geological periods subsequent to the Permian have left no traces whatever of their existence in the Tsun-lin. All that afterwards occurred was caused by the action of the wind and by the accretion of fluvial deposits.

The outlying hills of sedimentary formation, which, towards the glacial period, were raised above the level of the then existing Kirghiz Sea, as is proved by the large and scattered boulders near to the northern base of the Tsun-lin to a height of 2400 feet, may be attributed simply to the accumulation throughout the course of many geological periods—that is, of several millions of years—of detritus washed off from the highlands. At some future time some curious remains of continental organisms, which during early geological periods existed in the Tsun-lin, may be found in these deposits.

The observations respecting the traces of ancient glaciers made in the topographical portion of this paper may lead to the following general deductions:—

1st. The glaciers among the mountain ridges of the Tsun-lin surveyed by me have now disappeared, excepting, perhaps, the somewhat doubtful ones seen from afar by Captain Protsenko at the summits of the Ala-archa.

2nd. When they existed they did not descend below an elevation of 2500 feet. The lowest traces of moraines were observed on the northern slope of the Kirghiznin-Alatau, in the Makmala district; and evidently they were not mere accumulations of stones from landslips, as the boulders are crystalline, while the nearest hills (some, however, standing at a distance of 10 versts) are composed of sandstone. Lower than 2500 feet there are no boulders in the Thian-Shan. They are not found in the steppes, consequently they were not dispersed by icebergs; and either the sea, which at one time covered this

steppe, did not attain to this elevation, or the glaciers did not descend to the level of the then existing sea.

3rd. Large masses of non-stratified marl with boulders are discernible only at the bases of the mountains at present covered with snow, or of those that approach the snow-line, *i.e.*, that are not less than 8000 feet in height, *viz.*, the chains of the Thian-Shan system. There are no such formations near the mountains of the Kara-taù system—for instance, near the Tersa, Arys, or Bugun—but only fine gravel formed from local detritus, metamorphic formations, and clay.

4th. The highest limits of these ancient glaciers I saw only in one place, *viz.*, in the lower hollow of the Kara-kyspak defile. The height of the snow-line during the glacial period, to judge from this locality, was about 8000 feet,—4000 feet below the present snow-line. The perpetual snow which now covers the Khirgiznin-Alataù and Urtak-taù is not sufficient in quantity to form glaciers, as it lies only on the summits of detached peaks.

5th. The moraines are generally found welded together into one mass, exhibiting a wavy surface and being rent by fissures, which are sometimes, even at the present time, occasioned by rain and snow water. Some piles of boulders, marking the places of former moraines, rise just above the surface. This is, in all probability, to be attributed to the gradual washing away of the moraines, caused by the melting of the ancient glaciers and by the elevation of the snow-line. The various deposits in the mountain valleys were also then washed away. Relative to these ancient glaciers and moraines, some may doubt whether these accumulations of boulders are not due to mountain-slips and to the subsequent action of water. But such an hypothesis is contradicted by the fact that the lowest limit of these boulders is 2500 feet. Mountain-streams washing through clay and boulders, even at the present time, detach them and carry them a great distance; consequently, the volume of water, which was here greater than that of the present mountain-streams, would have transported the boulders much below the limit of 2500 feet, favoured, too, by a decline of 600 and even 1000 feet in 20 versts between the mountains and the present road from Tokmak to Aulié-ata. It therefore follows that the force which set these boulders in motion was not water, but something that arrested them in their descent on reaching a certain limit half-way down the mountain. Now, boulders are thus propelled only by glaciers, the downward course of which is checked by the thawing of their lower ends.

The formation of these ancient glaciers may be more cor-

rectly associated with the former connexion of the Caspian Sea and the Sea of Aral with the Balkhash and the Arctic Ocean, the traces of which in the Kirghis steppe are mentioned by Humboldt.* I saw these traces in 1858, and farther east in 1864; but there is no occasion to enter here upon the hydrography of Eastern Europe and North-western Asia during the Glacial period.† I shall here only observe that the *average* annual temperature could, even then, have been little lower than at present; but the summer heats were not so great. Besides, the climate on the sea-coasts was evidently more moist than it is now; and this moisture, even with less frost than at present, was sufficient to produce upon the mountains masses of snow which are not now to be found.

There are no volcanic formations in the western portions of the Thian-Shan which I surveyed. From eastern sources Humboldt refers to evidences of volcanic action further south in the Ak-tau; but even these are doubtful. Fire may be produced in the mountains even by the ignition of the seams of coal, as well as of the carburetted hydrogen-gas filling the caverns of the seams. This conjecture is supported by the circumstance that Messrs. Bogoslovski and Lehmann discovered, on their journey to Bokhara, a burning seam of coal in the mountains at the Upper Zarafshan, a little to the south of the Ak-tau. Speaking generally of volcanic action in the Thian-Shan and the surrounding regions, the geological surveys hitherto made from Khan-tengri (east of Issyk-kul, near the sources of the Touba, Djirgalan, Tekes and Kegen) to the extreme western limits of the system, have given only negative results. To the east of Khan-tengri there are again seams of coal—for instance, at Kuldja, and perhaps also at Urumchi—the ignition of which is quite sufficient to create explosive gases. Whether the seams of coal were ignited at Urumchi by volcanic agency, or accidentally at their denudations, is a question that cannot be settled without close observation. It can only be said that the demonstrations in favour of volcanic action adduced by Humboldt are not sufficient proof of the volcanic origin of the Thian-Shan, excepting only as regards the lava, which, according to Chinese records, flowed from the Peshan Mountain during the sixth century. But a single crater—even if the fact of its exist-

* 'Central-Asien,' I. Band, II. Theil, übers v. Mahlmann.

† I have only just commenced the study of the Glacial period in the Western Thian-Shan. A more minute explanation, plans, sections and views of moraines, on examination of the valleys where ancient glaciers existed, &c. &c., are yet to follow from another journey that I am about to undertake. I shall then be able to write more in detail on the Glacial period in Asia. Here I can, but for the first time, adduce proof that I am probably not mistaken in the discovery of its traces.

ence in an extensive mountain system extending, as the Thian-Shan does, for 3000 versts can be proved—does not make the whole of the range volcanic. Such a crater may belong to a volcanic chain intersecting the Thian-Shan, and this chain is, in reality, that of the Baikal.

Allusion may here be appropriately made to the relative antiquity of the Thian-Shan, and to the elevation of the high Gobi steppe from the upper course of the Onon through Urga, and further to the south-west. This elevated plateau also stretches from north-east to south-west. Humboldt considers it to be the most ancient “upheaval” of Asia: of greater antiquity even than the great central Asiatic ranges. But the information communicated by Radde concerning its north-eastern extremity, and relative to its salines and saline mud and lakes, corresponds so closely with what I saw in the Aralo-Caspian steppe, which was, geologically speaking, not very long ago a sea-bottom, that it is difficult to admit the antiquity of the Gobi. This steppe, like the high Sahara, was, in all probability, elevated during the latest geological period, while the formations of the Thian-Shan hitherto examined are all palæozoic.

II.—Here I must also remark on the orography of the Kirghiznin-Alataù, which I saw only on my way to the Thian-Shan. The directions of the ranges in this system are identical with those of the Thian-Shan, viz., north-east, south-west, and east, west; but the grouping of particular ranges is different, and entirely the reverse of what I observed in the Urtak-taù and in the ranges parallel with the Chirchik, especially to the west of the main snowy range of the Alataù.

In the Alataù several elevations east to west, are intersected by one north-east, south-west; and in the Urtak-taù also, as Mr. Semenov found in his exploration, the direction north-east, south-west, is the latest. In the western Thian-Shan it is otherwise. The sedimentary formations in the Alataù are exclusively palæozoic. No metamorphic strata with organic remains, upheaved in a direction north-east, south-west, and capable of serving to determine the antiquity of this upheaval, have as yet been discovered. Carboniferous formations have been upheaved in the small ranges bearing east by west of the Alataù system, as well as in that of the Thian-Shan running in the same direction.

The Alataù system may, therefore, be considered as having a character of its own quite distinct from that of the Thian-Shan, although having a geological connexion with it. From the gradual deviation from one direction to the other (from north-east, south-west, through east, west, to south-east, north-west),

and from the simultaneousness of their upheaval east, west, in the Thian-Shan and the Alataù, the sequence of geological revolutions in Central Asia may be thus represented:—

1st. Ancient upheavals north-west, south-west, in the Western Thian-Shan.

2nd. Their deviation to a direction east, west.

3rd. Upheavals east-west and south-east, north-west in the Western Thian-Shan and the Dzungarian-Alataù.

4th. Upheaval north-east, south-west, in the Alataù; the second of this direction.

5th. The Gobi elevation, also north-east, south-west, the third in this direction; and the formation of the Baikal volcanic zone.

It may be said by many that these deductions are premature, not being sufficiently grounded upon observation. I do not consider them myself to be finally decisive on the subject here treated of, in respect of the geology of Asia, but they will not be without use in the elucidation of the scientific questions that have yet to be solved. They are just as definitive as the incomplete observations upon which they are founded can allow, and no more.

III. The prevailing direction in the Kara-taù * system is south-east, north-west, *i.e.* the direction of the Himalayas. As mentioned above, it commences in a wide convexity, of which the axis—the Kulan range—bears s.s.e., n.n.w., which is an almost meridional direction. From the northern extremity of this plateau, a range with a general direction s.s.e., n.n.w., detaches itself. How the strata in this range extend, I am unable to say.

As regards the meridional portion of the Kara-taù, the two above-mentioned directions towards which the strata (the schist on the Tersa) extend, that towards north-east, south-west, is the most ancient; and that extending n.n.w., s.s.w., the more recent, having carboniferous and Permian formations. In the Ulkunburul the latter are upheaved in a direction s.s.e., w.s.w., deviating almost to east, west. The latter direction of mountain ranges, with that of north-east, south-east, occurs also in the Western Kara-taù, affecting equally the carboniferous and more ancient strata, viz., schist, limestone and sandstone, which have consequently all been upheaved together.

It follows that the upheavals in the Kara-taù took place at the same geological epoch as those of a corresponding direction in the Thian-Shan, the difference being that the more ancient

* There is another range corresponding to the Kara-taù in its direction, viz., the lesser Kurdai Range on the right bank of the Chu, which is geologically known. I saw it only from a distance, and for this reason do not describe it.

upheaval was weaker and formed only an addition to the Thian-Shan in the flat elevation of the Upper Tersa, which was hardly raised at all independently of the nearer portions of the Urtak-taù. The later upheaval was considerably more powerful, viz., that which formed out of the Kara-taù small separate systems in a direction towards the Himalayas.

Thus, in this respect, Humboldt was correct in connecting the Kara-taù with the Bolor, which, as has been said before, is the north-western portion of the Himalayan system.

IV. I have already dwelt upon the relations of the latter to the Thian-Shan. As regards the period of upheaval in the north-western Himalays (southern Tsun-lin), judging by analogy between its direction and the Kara-taù, and by the upheaved strata of coal which Messrs. Bogoslofski and Lehmann noted at the upper Zaravshan; it may be argued that these upheavals occurred simultaneously with those in the Thian-Shan in a similar direction; but it cannot be determined without thorough investigation whether the upheavals north-east, south-west, in the southern Tsun-lin were contemporaneous with those of the Thian-Shan, or with the later ones in the Dzungarian-Alataù. There is this circumstance in favour of the first conjecture, that the ranges bearing in this direction are of more frequent occurrence, as those abutting on the Urtak-taù parallel with the Chirchik. The name of "Bolor" in the sense of an entire mountain system, which I have denominated the Southern Tsun-lin, should, in my opinion, properly be excluded from the geography of Asia, because it is really *not the name of a mountain system*, and in this sense is therefore an error. Bolor is the name of a river, and of a town situated upon it; and is besides, according to Central Asiatic usage, the term for the one mountain from which the Bolor issues. They perpetuate an error by giving this name to a mountain region which has for several ages borne another appellation, instead of one that is general, and at the same time most appropriate, viz., "Tsun-lin." And this name will be preserved in geography, although the Tsun-lin, as we have seen, does not constitute a complete and independent mountain system, being formed by the western converging extremities of the Thian-Shan and the Himalayas. Both of these ranges, however, at their junction assume one common character as to their orography, somewhat distinct from that of their more distant elevations, as is illustrated by the dispersal of their peaks, and by the numerous short ranges that detach themselves, and intersect each other.

The real orographical import of my observations on the mountains between the Chu and the Syr-Daria, cursory and incomplete as they doubtless are, lies in the sufficiency of my

explanation of the construction of the enigmatical Tsun-lin Mountains, and in the confirmation of the ideas of Huen-Tzsan, and of the Chinese generally, concerning them, viz. that they are not the mountain-knot of the Kuen-lun and Bolor, as Humboldt thought; but an extensive mountain region, formed by the meeting and blending of two distinct and colossal systems, those of the Thian-Shan and of the Himalayas.

The Kuen-lun and Bolor, as we have seen, do not form separate ranges, but both belong to the Himalayan system.

Speaking generally, Humboldt's *five* mountain systems of Central Asia, viz. those of the Altai, Thian-Shan, Kuen-Lun, Himalayas, and Bolor, are thus, according to more recent explorations on the spot, commencing with Cunningham's 'Ladak,' reduced to three—the Altai, Thian-Shan, and Himalayas.

Humboldt further considers that the principal and most fundamental feature in the orography of Asia is its long mountain ranges. To elevated table-lands he imparts only a secondary orographic significance (in contradistinction to Iran, where they prevail); and he repeatedly urges his view, chiefly on the ground of the concavity of Turkestan or Lop-Nor.

It is true that Central Asia is not one vast table-land; but if Schlagintweit's opinion as to the altitude of Kashgar and Yarkend* be correct, then the Lop-Nor concavity cannot be called a depression; and is only a concavity in comparison with the enormous heights skirting it, viz., the mountain systems of the Thian-Shan and the Himalayas.† Properly speaking, it is all a high table-land—an intermediate decline between Thibet and Siberia.

Humboldt's delineations of long ranges must evidently disappear from the orography of Central Asia, at least as constituting its principal feature, since the Thian-Shan and the Himalayan systems respectively represent a wide and continuous convexity, upon which rise numerous ranges subsidiary to the general convexity, and consequently of secondary orographic importance.

In the Thian-Shan this general convexity is of no great elevation; but towards the west, in the Thian-Shan portion of the Tsun-lin, it attains a height of 5000 feet at Issyk-kul, 10,500 feet at Son-kul,‡ and 7000 feet at the Upper Chirchik. To the east of the Issyk-kul table-land the Thian-Shan may perhaps appear in the form of one long ridge, but probably with a some-

* He estimates them at 3000 to 4000 feet above the level of the sea.

† The Kuen-lun alone abuts on the Lop-Nor level from the south; but this is only the northern margin of the elevation of Thibet, or of the Himalayan system.

‡ Where Captain Protsenko found ice even in June, though partially thawed.

what broad sub-montane belt on the north, the existence of which is not, however, positively ascertained.

But in the Himalayan system, commencing from Rian-kul and Kara-kul, the ridges scarcely rise above the general elevation of 14,000 to 17,000 feet, excepting in the case of isolated peaks. This elevation fails to be attained only in narrow valleys having the character of clefts.

The Altai also presents the appearance of a wide protuberance, studded with numerous ridges.

By referring thus critically to Humboldt's great work on Central Asia, the idea crosses my mind that the reader may imagine it to have been done with the object of enhancing the value of my own humble explorations. Still, I have no fear. I have opened my paper with a quotation from Huen-Tszan, and have accepted this quotation literally, as it ought to be understood; instead of using it for the purpose of determining the supposed continuity of the chain of the Bolor (which is not recognised as a range by Huen-Tszan), because of two reasons: firstly, the fact that I was there at the time of Gen. Cherniayef's expedition across the Chu; secondly, because of Lyell's geological theory of slow, gradual, and constant changes taking place upon the earth's surface, instead of that of rapid and general Plutonic convulsions simultaneously upheaving lengthy mountain chains, and of intermitting periods of repose when sedimentary deposits were formed.

Humboldt held the latter theory, which was in vogue during the period from 1820 to 1840. It rested to a very considerable extent upon his own geological observations in the Cordilleras; and it guided him when he wrote upon Central Asia, his Asiatic sources of information being meagre and unscientific. This geological theory must necessarily have misled even so scientific a genius when treating of mountains he had never seen.

My almost polemical tone refers to this antiquated theory only. It is now abandoned by geologists, but the theoretical systems of orography based upon it still survive, and continue to have weight only on account of Humboldt's authority, who was the founder of the present theory of orography and of physical geography generally.

It is, however, time to reconcile the geological theories of the present day, with respect to the processes which have caused the variations of the earth's surface, with orography. No theoretical construction of the general direction of long ranges is needed for the purpose; it is enough, avoiding these altogether, to be guided by the simple acquisition of facts.

Ritter's orographical deductions relative to Central Asia, contemporaneous with those of Humboldt, although independent

of the geological teaching of any one, are for this reason not so complete as those of Humboldt; but, on the other hand, they will never become obsolete. They will be subject only to amplification, not to destruction. And yet they are not so suggestive, and do not equally stimulate fresh scientific exploration; and especially they do not afford the clue to new discoveries, like the ingenious, though often incorrect, geographical constructions of Humboldt; since those of the latter directly indicate the points particularly to be observed for the acquisition of correct scientific knowledge relative to an unknown country. Such is the character of Humboldt's genius. Even when erring, he renders services to science, for he makes the solution of the questions that he proposes easy even to an indifferent explorer, who has been placed for the purpose in much more favourable circumstances than he was himself.

The instruments used by me in these measurements were Greiner's hypsometer, indicating only temperatures $+92^{\circ}$ Cent.,* and a barometer made by Brauer of Pulkova which was in a damaged condition when I received it from the Imperial Geographical Society; it was, however, very well repaired by Mr. Noak, a mechanist attached to the Physical Cabinet of the Academy of Science. The tube of this barometer got broken on the way from St. Petersburg at Fort Vernoe. At Aulié-ata a new one was cast out of some spare ones, and this was carefully tempered.

As regards the calculation of the heights, in the absence of corresponding observations, we might have calculated the altitude of the measured peaks, by reference to the barometrically determined situation of Fort Vernoe, and have obtained the absolute heights from these relative ones; but the deviations of the isolated observations from the mean heights, as indicated by the barometer, on the points under measurement would then, nevertheless, have remained unascertained. I therefore preferred, instead of making calculations, to transcribe from Schlagintweit's '*Travels in India and Central Asia*' (p. 11, Hypsometry) the figures of absolute heights corresponding with the barometrical heights similar to my own. Then, also, when I found in Schlagintweit different figures for identical indications of the barometer, or varying indications of the barometer for equal heights (which is unavoidable in determining the latter by separate observations), I took into consideration in my selections both wind and weather. And besides, from among Schlagintweit's measurements, I guided myself in preference by those

* *I. e.*, downwards from 101° to 92° Cent.; below, the mercury contracted into the globe.

TABLE OF HEIGHTS, MEASURED IN 1864,* BETWEEN THE CHU AND THE SYR-DARIA RIVERS.

NAMES OF PLACES AND OBSERVATIONS.		Boiling Point by Hypsometer.	Rise of Barometer.	Thermometer with Barometer.	13-13½° Barometer set to 13½° R.	Absolute Height.
I. TRANS-ILIT-ALATAÛ.						
1. Fort Vernoi, 2nd (14th) May	.. .. .	98.69	Eng. half lines.	Reaumur.	552.08	Eng. feet.
Ditto 3rd (15th) "	.. .. .	97.79	..	..	554.05	2,300
Ditto by Golubev's determination	.. .. .	..	..	..	..	2,400
2. Kastek defile, opening at the lowest limit of ancient moraines, on the 7th (19th) May, 3 p.m., after rain. Hypsometer 95.65-95.69. A steppe grass "Chü" .. .. .	.. .. .	95.67	..	..	512.76	4,300
3. Pass from the River Kastek to the Chu Valley, at the upper course of the Kara-Bulak, midday, 8th (20th) May, weather lowering, IV. .. .. .	.. .. .	92.63	..	..	458.08	7,500
4. Kara-Bulak, at the foot of the mountains (Valley of Chu). 10th (22nd) May; morning, cirrhi .. .. .	.. .. .	96.36	..	..	525.89	3,570
Ditto according to Venukhof ('Imperial Geographical Society,' 1861, IV.) .. .. .	.. .. .	..	..	..	..	3,600
II. KHIRGIZ-ALATAÛ.						
5. Tokmak, 20' above the Chu Valley, 40' above the river, 16th (28th) May; morning, clear, E.N.E. .. .. .	.. .. .	97.40	..	..	547.07	2,700
6. Lower limit of pine (Picea Schrenkiana), in the Issyk-Ata defile, 16th (28th) May, 7 p.m., calm, clear .. .. .	.. .. .	94.78	..	..	496.24	5,300

7. Road from Tokmak to Merké, between River Chu and mountains, Kara-Balta Settlement, 21st May (2nd June), evening, clear, calm, cumuli and cirro-strati on the horizon	97·61	..	550·34	2,500
8. Fort Merké, 24th May (5th June), midday, clear, gentle, E.N.E. breeze, cumuli on the horizon	97·93	..	556·89	2,100
9. Lower limit of limestone in defile of River Merké, 25th May (6th June), evening, clear, cirrus. There is also the limit of yellow briar, generally of brushwood and mountain grasses. A spring here, 6·2 R.	96·83	..	535·03	3,300
10. Defile of river, 1st Ourianda, nearly lower limit of limestone,† within 6 versts (4 miles) from entrance, 27th May (8th June), 6 P.M., lowering, rain until half an hour before observation ..	95·74	..	514·11	4,200
11. Koi-Nar-Tas Pass, between 1st and 2nd Ouriandas, 28th May (9th June), 10 A.M., clear, cumuli	93·66	..	476·04	6,550
12. Summit of Koi-nar-Tas Mountain, 100 feet above the pass, composed of limestone .. .. .	..	..	..	6,650
13. A spring of the same name, about 300 feet below the pass, 5·3 R. .. .. .	..	..	..	6,200
14. Upper course of 2nd Ourianda, lower limit of snow in ravines, <i>Juniperus Sabina</i> , <i>Ribes</i> sp., growing, 28th May (9th June), midday, clear, calm	92·78	460·67	460·67	7,400
15. Sources of 2nd Ourianda, 200 feet still higher, estimated by sight .. .. .	..	..	..	7,600

* The heights marked with an asterisk (*) were measured by myself.
 † Here is also the lower limit of a kind of Mountain Liliacea, bearing yellow flowers, clustering thickly on the upper part of the stalk to 1½ to 2½ feet. There are similar plants, but with pink flowers, more to the east, in the Trans-Ili-Alatau and Kirgiz-Alatau. The highest limit is below 6000 feet.

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TABLE OF HEIGHTS, MEASURED IN 1864, BETWEEN THE CHU AND THE SYR-DARIA RIVERS—*continued*.

NAMES OF PLACES AND OBSERVATIONS.	Boiling Point by Hypsometer.	Rise of Barometer.	Thermometer with Barometer.	13-13½ Barometer set to 13½° R.	Absolute Height.
16. Pass to Kara-Kystak, mercury of Hypsometer in globe, 28th May (9th June); barometrical measurement, 22nd August (3rd September) made in the evening, N.N.W., cloudy	Eng. half lines. 430·7	Reaumur. 9·3	431·05	Eng. feet. 9,200
17. Limit of sandstone and limestone on the 3rd Ourianda, 29th May (10th June)	95·31	..	..	506·04	4,500
18. Lower limit of juniperus, mountain ash, and black currant, about 200 feet higher	4,700
19. Spring between 3rd Ourianda and Kara-Kystak in foreland of sandstone, temperature 7·2 R., about	3,000
20. Aulic-Ata. Depressed bank of Talas, 9th (21st) June, morning clear	98·16	..	..	..	..
21. Aulic-Ata, 3rd (15th) July, 2 p.m., clear	551·9	27·2	..	..
4th (16th) July, 2 p.m., clear, calm, clouds from S.	551·8	27·0	..	..
5th (17th) July, 1·30 p.m., clear, calm, clouds from S.	551·8	27·0	..	..
7th (18th) July, 7 a.m., clear, gentle, W.S.W. wind, clouds from S.	553·5	27·2	..	..
Mean	554·0	26·0	..	..
22. River Kara-Archa, lower limit of <i>Juniperus pseudo-sabina</i> , 17th (29th) August, 1 p.m., clear	552·6	27·0	551·09	2,460
23. Pass Tabash-Ata (source of the Kaında) to the Talas, 18th (30th) August, 10 a.m., clear, N.W.	534·2	25·5	532·57	3,150
	..	508·41	25·5	507·28	4,550

24. Talas, 5 versis above lower limit of forest in its valley, 18th (30th) August, 1 P.M. .. .. .	..	524.2	24.0	523.07	3,500
25. Talas, somewhat above the mouth of the Kenkol, 19th (31st) August, midday, clear, S.W. wind, gentle	95.82	..	..	515.61	4,100
26. Talas, confluence of its upper courses, the Kara-Kol, with the Uich-Kosh-Sai, 20th August (1st September), clear, gentle, N.E.	95.46	..	..	508.84	4,500
27. Taldy-Bulak, a brook on the southern slope of the Rangé, between the Kara-Kol and the Kara-Kystak, Aconitum and gentianae growing .. .. .	..	448.7	11.8	448.85	8,150
28. Pass from Taldy-Bulak to the Kara-Kystak, 21st August (2nd September), midday, lowering, calm wind shifting from N.E. to S.W. .. .. .	..	429.6	10.4	429.84	9,300
29. Longitudinal valley at upper course of Kara-Kystak, with moraines, confluence of its two sources, 22nd August (3rd September), 3 P.M., N.N.W., clear .. .. .	..	526.0	18.0	495.34	5,300
Pass to the Ourianda, see No. 16. ,					
III. URTAKTAÛ AT THE UPPER COURSE OF THE CHIRCHIK (CHATKAL).					
30. Chemget Spring (affluence of the Talas), at the southern base of the Cha-Archa Mountains 16th (28th) June, midday, clear, gentle, W.	96.99	..	..	540.55	3,000
31. Summits of the Cha-Archa ridges, at the outbreak of the Talas, 1000 feet higher, estimated by sight .. .. .	..	..	..	..	4,000
32. Kara-Bura River, within 3 versis (2 miles) of its issue from the Urtak-taù Mountains, 17th (29th) June, morning, calm, clear .. .. .	..	492.94	19.0	525.9	3,350
33. Kara-Bura River, lower extremity of its defile, at issue from the mountains, 17th (29th) June, 10 A.M., calm, clear	96.54	526.41	20.5	524.32	3,400

TABLE OF HEIGHTS, MEASURED IN 1864, BETWEEN THE CHU AND THE SYR-DARIA RIVERS—continued.

NAMES OF PLACES AND OBSERVATIONS.	Boiling Point by Hypsometer.	Rise of Barometer.	Thermometer with Barometer.	13-13½ Barometer set to 13½° R.	Absolute Height.
34. Confluence of the two head waters of the Kara-Bura, 17th (29th) June, midday, clear, calm (the river here issues from the main range, and enters the sub-mountainous region of conglomerate) .. .. .	..	Eng. half lines. 517·58	Reaumur. 21·0	516·81	Eng. feet. 3,950
35. Lower limit of Birch in the defile of the Eastern Kara-Bura River, 18th (30th) June, morning, calm, clear	94·83	491·51	16·3	491·24	5,600
36. First denudation of limestone from below, at the Eastern Kara-Bura, a little below the lower limit of Birch, 19th June (1st July), morning, clear*	95·19	489·90	19·5	489·30	5,650*
37. Confluence of upper sources of Eastern Kara-Bura; turn towards the pass across the water parting of the Talas and Chirchik, about 400 feet above the lower limit of <i>Juniperus-pseudo-sabina</i> , 18th (30th) June, midday, cloudy .. .. .	..	460·6	14·0	460·54	7,400
38. Mouth of Taiy River into Eastern Kara-Bura, near lower limit of Birch and Willow, 21st June (3rd July), 4 p.m., lowering; a spring here, 6·4 R. (Locality higher than No. 36, though very little. Between Nos. 37 and 38 a spring, 4·2 R., near lower limit of <i>Juniperus pseudo-sabina</i>).	..	497·81	18·0	497·33	5,200*
39. Extreme limit of birch and high-trunked <i>Juniperus</i> on the northern slope of Urtakab, near the source of the Kara-Bura, 22nd June (4th July), 6 p.m., lowering, No. 10 (Here is also the limit of the Mountain Ash).	..	437·8	13·0	437·8	8,700
40. A few short-trunked (but not yet spreading) <i>Juniperi</i> , about 200 feet higher .. .. .	..	..	..	..	9,000†

41. Extreme limit of spreading <i>Juniperus</i> , <i>i. e.</i> every kind of tree, and great accumulation of snow in gorges, 22nd June (4th July), evening, as on 28th June (10th July)	414·9	10·5	414·65	10,000
42. Pass from Kara-Bura to Kara-Kyspak River, <i>i. e.</i> from confluents of River Talas to those of the Chichik, no snow, 22nd June (4th July), evening, No. 10, lowering	408·0	7·3	408·56	10,500
43. Confluence of the two upper sources of the Kara-Kyspak, near the pass, 23rd July (4th August), 9 A.M., clear	423·8	18·7	423·34	9,600
44. Upper limit of leafed brushwood, at the Kara-Kyspak, 23rd July (4th August), 11 A.M., calm, clear; a spring here, 2·4 R. ..	433·2	20·4	432·57	9,100
45. Upper Snow Slip at the Kara-Kyspak, 2 P.M., clear	442·2	18·0	441·78	8,650
46. Lower Snow Slip at same place, between snow-covered mountains; upper limit of willow and birch near the southern base of the range, 23rd July (4th August), 6 P.M., clear, calm ..	454·1	13·4	454·1	7,450
47. Valley of the Chatkal (Upper Chirchik) at the opening into it of the Kara-Kyspak, 24th July (5th August), 10 A.M., S.W., cloudy, rain alternating with sunshine	458·3	14·5	458·19	7,100
48. Upper limit of <i>Hippophloe rhamaoides</i> , in the Chatkal Valley, near Chinash-Kourgau, 25th June (7th July), midday, clear, S.W.	478·4	16·0	478·14	6,350
49. Upper limit of Hawthorn (<i>Cyathæus sp.</i>) at the Chatkal, 16 versets (10½ miles), below Chinash-Kourgau, 25th June (7th July), 3 P.M., S.W., cloudy	484·9	17·2	484·52	6,000
50. Spring at the Chatkal, at the mouth of the Chaknak, 10 versets (6½ miles), below the mouth of the Kara-Kyspak, temperature 4·4 R., 27th June (9th July), 7 P.M., clear	464·7	12·2	464·8	7,000

* Measurements, Nos. 35, 36, and 38 were made over the extent of 1 verst (two-thirds of a mile). The order of the situations follows the stream; the river accordingly runs as it were uphill. These observations may indicate the margin of inaccuracies from the figures relative to the weather. The winds in the defiles could not be noticed.
† *Sic* in orig.

TABLE OF HEIGHTS, MEASURED IN 1864, BETWEEN THE CHU AND THE SYR-DARIA RIVERS—continued.

NAMES OF PLACES AND OBSERVATIONS.	Boiling Point by Hypsometer.	Rise of Barometer.	Thermometer with Barometer.	12-1310 Barometer set to 1310 R.	Absolute Height.
IV. KARATAÛ SYSTEM, VALLEYS OF THE TERSA, ARYS, AND BUGUN.					
51. Pass across the Kuyuk Mountains, at the sources of the Kuyuk Rivulet, 8th (20th July), 9 A.M., clear, calm	Eng. half lines. 537·3	Reaumur. 20·4	536·53	Eng. feet. 3,000
52. Ford over the Tersa River (Tersa-Akhan), 8th (20th) July, 10 P.M., clear, calm, after gentle N.E.	535·5	20·8	534·69	3,100
53. Kok-Sai Mountains, in the Urtak-taù range, from calculation of angle of elevation and distance by measurement, 10,150 feet above the Tersa valley-point, No. 52	13,250
54. Ak-Sai Mountain, in the Urtak-taù range, by same measurement, 11,725 feet higher than the same point	14,825
55. Pass from Chakpak, affluent of the Tersa, to the Arys, about 500 feet higher than point No. 52	3,600
56. The Arys, 35 verst (23½ miles), from its sources, 10th (22nd) July, 6 P.M., clear, gentle, N.E.	555·6	22·2	554·61	2,200
57. The Arys, 10 verst (6½ miles), lower, 13th (25th) July, 11 A.M., gentle, N.E., clear; a spring here, 10·3 R. (Yaski Chu midway between the mouths of the Kulan-Su and Mashat).	..	562·3	31·2	560·4	1,950

58. The Arys, 15 verst (10 miles), above the mouth of the Boroldai, 14th (26th) July, 7-30 P.M., clear, calm; in daytime a varying wind, N.E. and N.W., near the level of the river .. .. .	..	572.3	22.8	571.22	1,570
59. The Arys, at the mouth of the Badam, 25th July (6th August), morning, clear, on crest 50 feet above level of river.. .. .	..	575.0	28.0	573.31	1,500
60. Highest point on the Boroldai Mountains, near the sources of the Bagun, 27th July (8th August), strong N.W., clear, 10 A.M. .. .. .	..	524.0	24.0	522.89	3,500
61. Town of Turkestan, at Mesjid of Hazret-Sultan, clear, hurricane (and consequently unreliable observations), 30th July (11th August)	99.53	589.87	..	589.87	400
62. Turlan Pass, summit of Karataù, between Turkestan and Chalak, 1st (13th) August	93.0	460.26	..	460.26	6,500
63. Coal at Kumyr-tas River, in longitudinal valley on northern slope of Karataù, 4th (16th August)	97.10	540.4	..	540.4	2,900
64. Büülü-Kul 31st July (12th August), evening, calm, clear.. .. .	..	574.0	27.0	573.26	1,800

relative to the Himalayas, where the vacillation of the barometer is most like what it is in Central Asia. The temperatures of boiling are set to the corresponding barometrical heights of Schlagintweit's table (see the same, pp. 83-87).

From a comparison of his measurements, and also of my own figures, of the heights of Vernoe, the Kastek Pass, and the River of Kara-bulak at its foot, with measurements of the same places made by Messrs. Semenof, Golubef, and Veniukof, it will be found impossible that the errors in the absolute heights of my table can exceed 200 or 300 feet. I believe that I have been accurate to within 100 feet, although, of course, I cannot afford mathematical proof of this. In my contemplated journey I hope, however, to establish the corresponding barometrical observations in known points, viz. at Chemkend and Aulié-ata, for the determination of heights. The adjoined Table can only, as a beginning, give approximations.

SUPPLEMENT TO M. SEVERTSOV'S MEMOIR.

(*Copy of Report to the Etât-Major*).

8th (20th) June, 1866.

I have the honour to report that the results of the labours of the branch of the Expedition entrusted to my charge have been the discovery of hitherto unknown coal-beds; the ascertainment of the extension and disposition of the coal formations in the Karataù; the discovery of a whole system of beds of gold dust by the affluents of the Tersa River, besides numerous beds of iron-ore. These discoveries were made in excursions into the Karataù, to the Tersa River, and to the headwaters of the Badam, during the month of May and in the beginning of June (1864). I could not undertake any excursions before May on account of the impossibility of obtaining a convoy, and the unsettled state of affairs consequent on the hostilities of the Bokharians. I started on my first expedition on the 5th (17th) May, with the object of first examining the coal-beds already discovered to the north of Chemkend, and then proceeding along the Karataù Mounts in search for fresh layers, intending to continue my explorations between Chemkend and Tashkend on the east side of the road, where coal was said to exist. During my compulsory stay in Chemkend, I was occupied in making a collection of birds, insects, and plants. One ornithological collection, by the 1st (13th) May, comprised as many as 1600 specimens; this has now increased to about 2000, and, subsequently to my journey of 1864, I have gathered a greater variety of species.

During the winter and early in the spring, I succeeded in ascertaining the following particulars relative to the rearing of silk-worms, which were required by the Geographical Society :—

As an industry, the rearing of silk-worms in the valley of the Syr-Daria is pursued only in Hodjend. It is also pursued in Namangan, which is situated, however, by the river itself. It is general along all the southern affluents of the Syr-Daria, and particularly common in Margilan. The places here named are the three great centres of the rearing of silk-worms, although the practice is also followed to a large extent throughout Kokan. As to Andijan and Usk, I obtained no information. The northern limit of the regular rearing of silk-worms is the Namangan range, and its south-western extremity, the Kuraska hills which separate the Syr-Daria from the Chirchik. Thus the rearing of silk-worms is confined to the valley of the Ferghanah or the Khanat of Kokan Proper.

The mulberry-tree is largely grown in all the villages along the Chirchick, but more for the sake of its hard wood; it attains considerable dimensions, 30 feet in height and 18 inches in thickness. In Tashkend alone, some few of the natives rear silk-worms, but only in the way of experiment, although they are successful enough. The eggs are, however, dear; selling at 1000 teugas per lb. But in Tashkend they are rarely to be purchased; and, even in Namangan and Hodjend, they are preserved by the rearers for their own use, very few of the cocoons being reserved annually for sale. In Tashkend it is found that the expense attending the rearing of the worms is too great to admit of any competition with those of the Ferghanah, and that fruit-gardens are more profitable; it is also considered in Tashkend too great a trouble to gather the leaves of the immense mulberry-trees, of which there are nevertheless but a few in each garden, and to attend to the rearing of the worms. Therefore the small householders pay no regard to this occupation, and it is only a few of the wealthy merchants of Tashkend who rear silk-worms in their suburban gardens, keeping hired labourers to look after them; but owing to the want of proper supervision by the master himself, during the process of feeding these voracious worms, the Tashkend silk is worse and cheaper than that of Ferghanah, of Hodjend, &c., although it reimburses the expenses and gives even a small profit. I was told as to Tashkend rearers, that they were not indisposed to increase their establishments.

It is to be hoped that the recent capture of Hodjend will promote this, if only the Tashkendians have calculated on the encouragement of their own industry, by an unfair removal of all the silk-worms from Ferghanah and Bokhara during the

war. There is yet a great deficiency in Tashkend of proper hands to do the work of unravelling the cocoons; there is no machinery for the purpose.

In Tashkend the rearing of silk-worms is a rarity, and is considered a novelty; and, although it has been carried on for ages, it is yet only experimentalized upon. As a branch of industry, it has been practised in Ferghanah from time immemorial.

Mulberry-trees are grown everywhere north of Tashkend, but they are not numerous, and there are very few in Aùliéta. In a small degree the silk-worm is permanently reared in Kornak, near Turkestan. Experiments in this line have been made from time to time in Sairam, Mankend, and Karabulak; but in those places there is now no mention of the rearing of silk-worms.

The process of nursing the worm is very simple, and is commonly known in Europe. The worm is produced from the egg in a little pouch on its surface, before the leaves of the mulberry-tree are out, which is in April; later the worms are fed on the plucked leaves in-doors, and small twigs are supplied to them, among which they form their cocoons. Samples of white and yellowish cocoons, of unravelled silk, and of the eggs, besides other specimens of native produce, were sent by General Cherniozef to Moscow, with Hadji-Yunusof, a very intelligent Tashkendian.

Tashkendians say that even when transported during the summer heats, the eggs do not mature into worms on the road, but it is better to convey them in the spring and autumn; moderate frosts, of 10° R., do not destroy in them the germ of life. There is not the least sign here of a disease among the silk-worms (M. Meazza and his companions said the same of Bokhara). Both worms and eggs are perfectly healthy; the latter are very sound, and not at all delicate.

The common mulberry-worm is produced here. I did not find here either the *Bombyx mori* or any other variety of the wild silk-worm.

I turn now to my excursions and to their results, which apply practically to the region.

On leaving Chemkend I passed through Karabulak, and across the Arys River to the Karataù, proceeding then along the south-west base of those mountains. On the 19th May, at the Katurgan-Su Rivulet, I was joined by Captain Nikolski, of the Mining Engineers, who had arrived in Chemkend on the day after I left. Keeping to the south-west base of the mountains, we traversed the river Boroldoi, both the Buguns, the river Soyan, and the Arystamdy, determining the topographical

and geognostic relations of the permian formations in the Karataù to the more ancient strata, which was the object of the excursion in this direction. On the 22nd May we reached the coal-beds by the rivers Batpak-Su and Isendy-Bulak, which were the first to be discovered in this region. After making a superficial examination of the disposition of the coal-layer, I parted from Captain Nikolski, who remained to make a more minute investigation into all the coal denudations in those parts, for the purpose of thoroughly studying the carboniferous formation of this region.

"I myself started for the rocky district of the Karataù, which had not yet been explored by any one, between the sources of the Babata River and the Turlan Pass, being accompanied by Skorniokof, the collector of the expedition, and by the dresser Shiliayef, both of whom very zealously occupied themselves in dressing the skins of birds and animals, and in preserving plants; while they exhibited great diligence and ability in following my directions in collecting specimens of ore and petrefaction.

Here I determined the position of a mineral vein, near the Turlan Pass, which M. Frehse had not visited. This vein is on the summit of one of the many parallel ridges compassing the Karataù, and occurs in a transverse cleft in the limestone; the vein runs from N. 40° E., and the limestone from W. 35° N. I afterwards found that all the mineral veins in the transverse clefts of the Karataù were similarly disposed. The ore is a mixture of *glittering lead* and other lead ore, with ochre of iron and lime. The *glittering lead* occurs either in lumps or in small crystals: the lead ore is cleansed by the Kirghizes at the scours of the mountain streams.

One exists also on the Ken-sara, in the rocks at the eastern extremity of the defile, where there is ochre, brown iron-stone, and *glittering lead*. A third mineral bed, not known even to the Kirghizes, we found by the Chulbar-Su; a thick vein of red *ochral* iron-stone, with sparkles of lead, protrudes in the rock.

Specimens of these ores were secured, and will be more minutely described by M. Nikolski, who is now fitting up a travelling laboratory in Chemkend. We likewise found in this part of Karataù layers of limestone, rich in lapidescences, in the Kandy-Mystaé locality, and at Usk-Tiubebas, by the sources of the Babata River. These layers, with the lapidescences, were discovered for the first time, and were traced by me throughout the whole extent of the Karataù, from Kandy-Mystaé towards the south-east, as far as to Boroldoi River; they are of great importance for the determination of the geological

construction of the Karataù Ranges. It appears probable from a first examination, and from a classification of some of these lapidescences, which I have made, that these limestones, with their predominating *Productus* and *Spirifer*, belong to the class of mountain limestone; but in order accurately to determine their antiquity, it is necessary to obtain defined specimens of various shells and corals, which are guides to the determination of all layers lying upon and under the limestone, of a more primitive origin than the carboniferous strata.

Joining Captain Nikolski at Djar-Tiubé on the Babata River, on the 24th of May, I learned that during my absence he had examined five denudations of coal on the Isendy-Bulak, and three on the Batpak-su rivulet. In each of these places he found only a thin layer of not more than six inches, and dipping abruptly. Mr. Tatarinof had found the same before him, the thick layer of coal in this locality, of which I remember M. Frehse to have made mention, was not discovered.

On the 25th of May I inspected the coal-bed on the Isendy-Bulak, together with Captain Nikolski, who afterwards, according to my directions, proceeded to Usk-tiubé-bas, to collect petrified specimens, whilst I ascended to the sources of the Bugun, to trace the connection between the coal leads there and those of the Isendy-Bulak. On this occasion I passed at last over the saddle-back of the Karataù, whence the Arystandy flows to the south-west, and the Usk-tas to the north, between the rocky mountains at the head waters of the Babata. Along the whole of this line of route I found denudations of a species of coal formation such as occurs at the Isendy-Bulak; viz. sandstone and conglomerate. Denudations of pure coal I did not find until I came to the Tayan; but even the conglomerate and sandstone were here in great abundance, cropping out only here and there from under the thick masses of detritus; the yare, however, characteristic, so that even before I had seen the coal, I had been able, in 1864, to come to the conclusion from them that there was coal formation on the Bugun, where, in 1865, M. Tatarinof actually found it, after, however, seeing my geological map. From the Tayan to the Bugun I also traced a continuous line of coal-formation. The collector Skorniokof discovered here a thin streak of coal, extending for two fathoms, exposed near a spring in the vicinity of the sources of the Sasyk.

On the Bugun I waited three days for Captain Nikolski, making in that interval small excursions in the neighbourhood of the denudation of coal found by M. Tatarinof. I here drew up section-plans of all the Karataù formation on the Bugun, though not along the whole of its course through the mountains. Coal formations were also found here, resting on solid

limestone conglomerate; closed in, between the Isendy-Bulak and the Usk-Tiubé-bas, by thick masses of deposit. Wild grape was found along the Bugun (afterwards also along the Boroldoi and Koturgan-Su), and a very good botanical and zoological collection was made here. Skorniokof picked up several petrefactions, while I geognostically determined the stratification of the bed in which they were found.* The defiles along the Bugun are wooded, as are also those in the mountains and by the head-waters of the Tayan, which nobody had visited before me. I was there too, for geological purposes. It may be here mentioned that the defiles along the Boroldoi and its affluents are equally wooded. The forests are all of the same kind; there are two kinds of ash and a tall hawthorn tree, the latter grows to a height of 18 feet, and is 8 inches thick; it is rarely higher, the old trees are mostly crooked, with forked or broken summits.

This timber is not fit for building purposes, but it will do for joiners' work, and for use at the arsenals; it may likewise be serviceable for coal mines, but the trunk of the hawthorn tree being short, and the copses lying in the narrow defiles, composed of one to three rows of trees, extending only a few versts, it is necessary to be economical in the use of timber in working the coal, and to utilize as much as possible the hard sandstone and limestone found with it. This is done in the copper mines in the Orenburg Steppes by the Takmara.

On the 31st of May Captain Nikolski returned from Usk-Tiubé-bas. We examined the denudations found by Tatarinof on the Bugun, after which Captain Nikolski left for Chemkend. When he had gone I continued the investigation alone, and discovered perfectly new coal-beds on the Little Bugun and the Boroldoi Rivers.

Coal was found on the Little Bugun, which, by means of specimens picked up from the débris, we were enabled positively to ascertain was embedded in flaky, resinous, and inflammable schist containing, in a state of very good preservation, bended boughs and fruits of various plants, blossoms of ferns, and fruit of coniferous trees, as well as fish of the order *Ganoidia*. The coal was black and glossy.

The conditions in this structure, namely, the presence of the schist next to the coal, are the same as those of the best coal-beds in England and Belgium, but the denudations on the Bugun are everywhere hidden by the detritus.

By analogy with Tatarinof's, and with the Isendy-Bulak beds,

* Not having seen M. Tatarinof since his return from Bokhara, I cannot say whether I have supplemented anything to his observations on the Bugun, or merely confirmed them.

these denudations must be sought for at the height of the frequent springs, on the slopes of the southern verge of the Little Bugun Valley, clearing the detritus away from the springs. Here and there are projections of sandstone of carboniferous formation, lying under the coal, and of finely stratified limestone next to the coal. A bed of conglomerate lies on the top of the limestone.

The same layers which are seen by the Little Bugun crop out by the River Malas, or the Northern Boroldoi, between two gorges formed by that stream. The lower stratum extends to the junction of that river with the Great Boroldoi. Here is an appearance of coal *subjected to the action of the wind*; it is flaky, and contains alternating and glassy veins, which owing to the windage have turned into an inflammable schist, not of a light-brown colour however; while the dark schistous clay is not combustible from the same cause. I tried to dig to the unwinded parts of the seam, but failed through lack of time. The similarity of the species in these denudations with that of the crumbling coal by the Little Bugun, inclines me to think that it is one single seam, cropping out at both rivers, or, rather, that there is here an entire system of seams, which is not a continuation of the larger by the Great Bugun, for the latter is not embedded in schist, but in a bluish stratified clay, as is the case by the Isendy-Bulak. I call this stratification by the little Bugun and Boroldoi a complete system, because three layers are visible by the Boroldoi, each being two feet thick; the general thickness of the denudations taken with the schist, where they are not covered with detritus, is 25 feet.

Judging from the height at which the Boroldoi denudation occurs—which is at the elevation of the spring by the Little Bugun, above the level of the seam on the Great Bugun—and seeing the similarity of the arrangement of the accompanying schist to the schist in the English coal-beds, it may be presumed that the thickness of the system of the coal-formations, taken with the schistous strata, is immense. To ascertain this exactly would require a concentration on the spot of all the mining operations of the Expedition; whereas the object of the Expedition is only to bring to certain knowledge the existence of mineral wealth in all parts of the entire region. But, although the thickest layer might not be worked upon, a seam might be selected which, with the means at hand, might be very advantageously examined into by the members of the Expedition.

There is no difficulty in bringing coal from the Little Bugun and Boroldoi in carts to the Syr-Daria. There is a sloping pass over the mountains, with a tolerably good cart-road between

the rocky defiles of these rivers. The distance from the mouth of the Aryn is not more than about 54 miles, from Chemkend 40 miles. Timber, for mining purposes, can be obtained by the Boroldoi.

There is capital iron-ore in the Boroldoi defile. This is red iron-stone, occurring at a distance of 1 mile from the coal denudation in the limestone; and almost at the same distance from the coal there are immense projecting masses of brown iron-stone on a flat elevation, broken by a cleft in the mountains. Iron-works may conveniently be established at this spot, where coal and iron lie in close proximity to each other; the produce of these works would find a ready sale in Central Asia, while the establishment would, at the same time, be a source of great benefit to the Syr-Darian flotilla. A tramway could be laid from the coal-mines to the steamboat pier on the Syr-Daria. The expense of constructing this road would be recovered by the economy of the transport of coal. Instead of a load of 7 cwt., drawn by a horse along an ordinary road, each car on the tramway would contain 32 cwt. of coal. In no other localities do coal and iron lie so close together.

On my way back to Chemkend from the Boroldoi coal-seams I perceived numerous veins of red iron-stone at the sources of the Katurgan-su rivulet.

I returned to Chemkend on the 6th of June, where I found two topographers and a convoy of fifteen men, for whom I had applied to General Romanovski in the month of April. The services of the former were required for the purpose of mapping those parts in the Karataù where I had been, of tracing my line of march, and of marking down the newly-discovered beds of ore and coal, and the denudations with the embedded petrifactions.

I at once employed the topographers in the construction of a map of the Karataù, on a scale of 10 versts, from the surveys made for drawing up a geological plan. The details I had inserted in my diary, and the sketches of localities which I had made on the road enabled me to fill in the blanks on the map.

On the 10th of June, I despatched seven of the men, with their apparatus, to the sources of the Badam in the mountains, from whence they returned with a large collection of birds, insects, and plants, reporting also that they had hit upon iron-ore in the hills.

On that same day I myself started with Captain Nikolski, M. Osokin, a gold-seeker, and with two miners, towards Aùliéta. We pushed along the road—taking no convoy—as far as the

Tarsinsk picquet, where, according to arrangement, we found riding-horses.

The object of this excursion was to find out a gold-mine, of which I had received intelligence in 1864, through the eldest son of Tiuringildy, a Khirgiz Bi, of the Chemyr tribe. His name I have, unfortunately, forgotten, but I shall do my best to learn it, in order that he may obtain his merited reward through the application of his superiors.

He more particularly deserves an acknowledgment of his services, because his indications were not vague, like all the rumours about gold floating throughout the Asiatic Khanats; and amongst them the *on dits* in these parts concerning the existence of gold somewhere on the Tallel and Chirchik Rivers, where one has to search for it from 100 to 200 miles up and down their course. This Khirgiz so accurately described the spot where the gold was to be found that, although I had never been there before, I led my small party, without a guide, and without even inquiring the way, directly, and without fault, to the identical place. We found it by the Kukreñ River, at its entrance into a rocky defile, in a schistous ridge of the Karatañ system, which is also cloven by the Tersa. The pebble-stone at the spot and in the neighbourhood is indicative of gold, being composed of diorite, sienite, and ochreous quartz, of which latter there is an abundance. Moreover, the presence of a superstratum of detritus over the schist, which stands up on end slantingly across the valley, in a direction north-west to south-east, corresponding with the direction of the Karatañ, appeared favourable for the formation of an auriferous bed. We selected a spot for working upon, but did not dig down to a gold vein; for, at a depth of about 6 feet, we came to water on a level with the rivulet. At a depth of 3 feet the welling of the water was so strong that the sides of the cutting gave way, and the pit was filled up with coarse-grained sand faster than the men could bale out the water which brought the sand in. We had, in the end, to abandon this cutting.

Gold was, however, found, though in small quantities, in some washings, beginning from a depth of 6 feet. The first three experiments in washing the still sands produced several grains of gold; but three other experiments in washing the *moving* sand did not succeed in bringing to light any of this metal.

From all these circumstances, and by analogy with all the Siberian mines of which I have read and where Osokin had worked, it may not be improbable that the auriferous layer is the deepest bed of detritus, the richest portion of this lying

upon the vertical schist, of which the frequent projections have arrested the gold deposited on the top.

Having found gold, I considered it advisable not to lose time in digging any fresh pits, the object of the excursion—which was definitely to settle the question as to the existence of gold-dust in the Turkestan province—having been already gained. After this Report I shall proceed to fresh coal-fields between the sources of the Kelés and Chirchik Rivers.

Similar pebble-stone to that of the Kukreù was also found by other springs and rivulets feeding the Tersa from the left side below Chekpak, which leads me to believe that there exists there a complete system of unexplored gold-mines.

The proportion of gold to the sand in the detritus thrown away in the course of clearing the pit by the Kukreù is 7 grains in about 3 cwt., which is very promising.

In this excursion I determined geologically the extreme south-eastern limit of the Karataù range, and positively assured myself that it is perfectly distinct from the Thian-Shan system. Even the slight connexion between the two, which I spoke of with some doubt in a former paper, is an optical delusion.

On the Kukreù I made some observations which confirmed those I had previously made with regard to the traces of the glacial period in this region. There cannot now be a doubt that there was such a period there. Besides unmistakable evidences of ancient moraines, I observed coble-stone of the Thian-Shan on the schistous elevations of the Karataù system, like the coble-stone of the Alps or the Jura. These could only have slid down the glaciers which descended to 150 feet above the base of the lower schistous hills on which they rested. The glaciers in those parts must have descended to 2000 feet above sea-level.

XIV.—*Notes on the Rivers Maué-assú, Abacaxis, and Canumá; Amazons.* By W. CHANDLESS, Gold Medallist R.G.S.

THE rivers Maué-assú, Abacaxis, and Canumá all discharge themselves into what is now called the Paraná-mirim de Canumá, a side-channel that, leaving the river Madeira about 45 * miles (geographical) from its mouth, after a course of some 245 miles, enters the Amazons just below† the town of Villa Bella. About 25 miles below the mouth of the river Maué-

* According to the map of M. de Castelneau. It seemed to me rather less.

† Also just above the town, by a small branch known as the Furo de Limão, which is the usual canoe-route.