

No. 9, *Remigia translata*, is recorded from Ceylon and from the Marshall Islands. I also met with this insect in the Ellice group.

No. 11, *Chloanges suralis*, occurs in Amboina, in the Marshalls, and Mr. Matthew took it in the Ellice group. Its food-plant occurs commonly in Fiji, but I never noticed the insect there, nor is it recorded among the extensive collection made there by Mr. Matthew. I did not notice it in the Solomons.

It appears probable, therefore, that the three last-named species have reached the Gilberts *viâ* the Marshall group. Two of them have travelled on to the Ellice group, but, so far as is known at present, have not extended further. To dragon-flies, at all events, the passage of large distances of sea presents few difficulties. I have on several occasions, during my travels in the Pacific, noticed their larvæ in the water brought on board ships when filling up the tanks. Once on the voyage from England to Australia a dragon-fly was flying about the ship, the nearest land at the time being the island of Socotra, distant about 500 miles. The habit that these insects have, as noticed by me in the Solomons, of flying after dark would most certainly conduce to the chance of their being blown out to sea, and so dispersed from island to island.

ATTEMPTS TO ASCEND MUSTAGH-ATA.

By Dr. SVEN HEDIN.

IN 38° 21' N. lat., the highest peak of the Kashgar chain, and of the whole of the Pamir plateau, Mustagh-ata, raises its head, covered with eternal ice and snow, to a height of about 25,000 feet above the sea. Thus, in respect to its geographical situation, this mountain plays the double rôle of being the strongest eastern outpost of the Pamir plateau, and the last north-western outpost of the earth's highest culminating points, which all belong to the Himalaya, Karakoram, and Tibet mountains. Among Mustagh-ata's nearest neighbours, it is the Karakoram peaks, Godwin Austen and Dapsang, that exceed it in height, while Hindu Kush's highest summits, Kauffmann peak and Tengri Khan, are not so high. Thus west of Mustagh-ata there is no mountain, either in the old or new world, which in height can compete with this giant.

The geographical researches of recent years have proved that the Pamir plateau, far from being a plateau in the proper meaning of the word, is a mountain mass cut up into the most varied forms of relief, although subject to the orographical law that mountain chains run in a latitudinal direction. Between these mountain chains the sources of the Amu Darya run towards the west, through valleys which in the eastern half of the highland are broad, and separated from each other by low mountain ridges, but which in the west become more and more deeply cut, and more wild and steep. As the Pamir plateau is bounded on the north by two parallel mountain chains, Alai and Trans Alai, and on the south likewise by two, the Wakhan and Hindu Kush mountains, so also is the case in the east, where the complicated mountain centre is encircled by two parallel, meridional chains, Sarik-kol and Mustagh, or,

as it is also called, the Kashgar chain. But while on the north and south the two outermost mountain chains, Alai and Hindu Kush, form the watersheds, the former between Amu Darya and Sir Darya, the latter between Amu Darya and the Indus, so on the east it is the innermost chain, Sarik-kol, which forms the watershed between Amu Darya and Tarim. Thus comparing the Sarik-kol and Mustagh chains, we find that, although the latter is much higher and more strongly developed than the former, it is nevertheless this one, Sarik-kol, which, in respect to its hydrographic importance, plays the chief part, separating as it does two river districts, whose innermost boundaries, the Aral Sea and Lob Nor, lie at a distance of over 30° from each other. As a result of the fact that Mustagh (not to be confounded with the more southerly Karakoram Mustagh) is included in the Tarim river district, this chain, in respect to its formation, is more developed, and shows more bizarre and wild surface-forms than Sarik-kol. The watercourses which run eastward from this watershed must pass the Mustagh chain in order to reach their destination; and Yarkand Darya, the mightiest river of the Tarim basin, Gez Darya, and Markan Su—both of the latter belonging to the Kashgar Darya river district—actually break their way through this chain by deep-cut transverse valleys, frequently bounded by perpendicular walls of rock. Lastly, we find that the average ridge-height (*mittlere Kammhöhe*) of the Sarik-kol chain is far inferior to that of the Mustagh chain, but that the average pass-height (*mittlere Passhöhe*) of the two chains is probably the same; yet, if one considers the relatively insignificant absolute height of the three deep transverse valleys, the average pass-height of Sarik-kol is possibly even higher. That is, in other words, the difference between the average pass-height and ridge-height of the Sarik-kol chain is much less than that of its eastern neighbour. A similar relation between pass-height and ridge-height we find also in the two chains Kwen-lun and Himalaya.

From that part of Pamir where Aksu, Kosh-agil, and Rang-kul are situated, and where one can speak of a plateau in the real meaning of the word, the ground rises slowly up to the generally broad and rounded crest of the Sarik-kol chain, only to fall again just as gradually on the east side toward the Sarik-kol valley. Of the three passes that I know by my own experience, Chuggatai, Muskuran, and Sarik-tash, none offer any difficulties worth mentioning; and Ak-berdi, Kara-tok-terek, and Yol-tok-terek are said to be equally easy. The Mustagh passes, which only need to be used during that portion of the year when the Gez-Darya route is impassable on account of the great quantities of water, are, on the whole, higher and more difficult. Kok-moinak, which I passed on July 5, is the easiest. Through Keng-kol, Tar-bashi, and Chit-jekli-davan one ascends gradually to the pass, from which a way leads down through the Derschet valley to the Tagarma plain. Merkebel

(north-east of Mustagh-ata), which I visited October 12, is much more difficult. On the crest of the chain, here somewhat cut up, a broad and thin glacier-tongue, comes down from the mountains south of the pass on either side; but especially on the east, it has formed great moraines, which in a high degree render passage more difficult. Kara-tash-davan, which lies somewhat north of Merke-bel, is said to be considerably easier than this, and also constitutes an important route between north Sarik-kol, and Kashgaria. Still farther north (north of Gez-Darya) we find the two passes Burukiss and Ulug-art, which, like Merke, are extremely seldom used. These



MUSTAGH-ATA FROM THE SOUTH-WEST.

passes are very unfavourable, for during six months of the year (from the end of September) they are blockaded with snow and ice; and even during the summer one must here, as at Merke, ride over the glacier-tongues.

The Mustagh chain is, on account of its situation and its considerable height, more exposed to the moisture carried to these parts by southern winds than the Sarik-kol mountains, which therefore, at least in the parts I visited, have no glaciers, and only in a few limited tracts have perpetual snow. Thus in a climatic respect the Sarik-kol chain belongs to the Pamir plateau with its dry atmosphere, while the Mustagh chain forms a more isolated climatic district, on whose slopes

and heights the air, laden with ocean moisture, has caused the formation of continuous fields of perpetual snow and firn-snow which cover the heights, and mighty glaciers, which in deep ravines flow down the mountain-sides. The eastern slopes of the chain facing towards the dry climatic district of Eastern Turkistan, are, consequently, poorly supplied with glaciers, which are, however, all the more plentiful on the western slopes. This grand glaciation doubtless protects the Mustagh chain from weathering, while the Sarik-kol chain, which rises in dry strata of air, has already lost its original ice-mantle, and has therefore gradually been more and more exposed to weathering, and, compared with its neighbour, has rapidly decreased in height. On account of the considerable average height of its passes, the Sarik-kol chain, nevertheless, is still the watershed—the only remnant it has retained of its former greatness and splendour, a circumstance which causes us to suppose that in ancient times it equalled or perhaps exceeded the Mustagh chain in height.

Although the extent and magnitude of the glaciation has, in the course of ages, decreased even on the Mustagh chain, and is slowly decreasing still, the glacial geologist or the alpinist finds here an inexhaustible field for observation. That the territory covered with glaciers was formerly vastly more extensive than it is now, is proved by the more or less weathered and eroded moraine débris which still cover the lower slopes of the mountain, and in places even blockade the Sarik-kol valley. One of these moraines which stretches across the valley has dammed it up, and caused the formation of Little Kara-kul and the two basins called Bassik-kul, and it is probable that even the lakes Chakeragil and Balun-kul have been formed in the same manner. Erratic blocks as large as 1000 cubic metres are by no means uncommon, and their situation, the kind of rock of which they are composed, and their polished or striated surfaces betray in an unmistakable manner their origin. During last summer on Mustagh-ata—*i.e.* the culminating point of the chain, which on our maps is frequently erroneously called Peak Tagarma—I explored seven large and several small glaciers; but, on account of the extent of the work, did not have time to fulfil my plan, which was to extend my researches even to other parts of the Mustagh chain. From Bassik-kul alone, there are no less than twenty-one glaciers visible on this chain.

Mustagh-ata (the "Father of Ice Mountains") is composed of gneiss of all colours and forms of structure, from coarse-grained and porphyritic gneiss (*augengneiss*) to fine-grained, with a transition to crystalline slate. On the northern portions of the mass slate is predominant, and gneiss in the southern part. The mountain is divided into two distinct parts, between which the mighty Jam-bulak glacier (which Bogdanovich named the Prjevalski glacier) has its firn district and its tongue. North of this rises an isolated summit, which can

be ascended only from the west, close by the glacier-passage. To the south lies the main mass of the mountain with four summits, of which the northernmost is the culminating point. Viewing Mustagh-ata from the west, for instance from Murgab, it may be plainly seen that these four summits, near their tops, gradually melt together into a cupola. On this cupola the armour-ice, which covers it like a calatte, is fully developed and of an enormous thickness. It is formed of firn-snow in the very highest regions, and slides down to the glacier collecting-basin; but even between the glacier-passages it reaches down in broad; thinner,



JAM-BULAK GLACIERS.

and still thinner tongues or wedges. The larger glaciers generally disappear at a height varying between 12,800 and 13,500 feet.

Mustagh-ata is a holy mountain. The Kirghiz frequently fall on their knees and pray when they pass by it, or when they first come in sight of it on a journey. The bones of seventy-two saints rest here, and the mountain is considered to be one great masar or grave of saints. Among those that here have their resting-place is Moses (wherefore the mountain is also called Hasrett-i-Musa), together with the prophet Ali, who, when he felt death approaching, predicted to his people that, when life had fled, a white camel would come from heaven and carry him away. After his death, the camel came, took the prophet on his back, and sped away to Mustagh-ata.

The Kirghiz of this district told me that only an old *ischan* had, many hundred years ago, ascended this holy mountain. There he had found a lake and a river, on whose shores a white camel grazed. In a

garden, where plum-trees grew in great abundance, old men were wandering about in white garments and with long white beards. The *ischan* ate of the fruit of one of the plum-trees, and then an old man came up to him and said that this was fortunate for him, for had he despised the fruit, he would have been compelled to stay eternally on the mountain like the other old men. A rider on a white horse then took him on his saddle and rushed off down the steep descent with him. When he came down into the valley, he had only a faint recollection of what had happened.

Once when the celebrated Khan Khodya was waging war against the Chinese, he was about to be overpowered at Little Kara-kul. At the last moment, forty stalwart horsemen on jet-black horses rushed down from Mustagh-ata and won the victory for Khan Khodya. In his army there was a hero, the *palevan*, Chum-kar-kashka-Bater, who had been told by his master never to look back when surrounded by the din of battle, and that if he heeded this advice he would always conquer. In three battles he did as his master advised him and conquered, but in the fourth he looked round, and was instantly hit by a fatal bullet. His *masar* (grave) is on the west slope of the mountain, where a whole tract of country still bears his name. The Kirghiz still relate that on the top of the mountain is an ancient city, Janaidar, which was built at a time when the people on the earth were all happy, and since, from that time till now, there has been no communication between this city and the rest of the world, its inhabitants are perfectly happy even to this day. There are gardens here that bear the most delicious fruits the year round; there are beautiful women who never get old; all the enjoyments of life are as common as daily bread; only death, cold, darkness, and misfortune are not to be found there.

Contemplating the projected journey to Mustagh-ata, I collected all possible information in regard to it from the Kirghiz. With one voice they told me that an ascent would be impossible: precipices and abysses hindered all progress; the sides of the mountains were covered with ice as smooth as polished steel, and the storm-king, who reigned supreme up there, would sweep us away like grains of sand; we should never come back alive. The Kirghiz in the neighbourhood of Su-bashi and Little Kara-kul, *i.e.* immediately at the north-western foot of the mountain, were less pessimistic in their opinions than their brethren in the interior of Pamir. Most of them were willing to accompany me and exert their strength to the utmost; but they believed, nevertheless, that the expedition would be a failure. Hunters who had strayed to a considerable height had become dizzy in the "heavy" air; and once, when a party of hunters had driven *arkaris* up against the steep ice-walls, even these agile and quick-footed animals had shrunk back. Even the wings of the eagle became benumbed before he reached the highest regions.

To attempt the ascent of such a mighty mountain as Mustagh-ata without an experienced and skilful Swiss guide is doubtless a risky undertaking, and one must entirely confide in one's own judgment and the Kirghiz instinct of locality. I found, however, many among them who were invaluable followers, and displayed an admirable perseverance. Experience has shown, and experiments with animals in rarefied air have confirmed the fact, that, in ascending mountains, it is not so much the rarefaction of the air which brings on fatigue and decrease of strength, as the physical exertions to which the climber is exposed. The increased muscular labour requires a greater supply of oxygen, but the quantity of oxygen decreases, instead, the higher one ascends, and at a certain height every distance of 10 feet is dearly bought, till finally a limit is reached where one's strength is no longer sufficient, and the limbs refuse to serve the body. If one wishes to reach a considerable height, one must consequently try to arrange the ascent in such a manner as will best spare one's own strength, and no one has a better opportunity of doing so than the aeronaut, who can, therefore, without special difficulty, live in air-strata considerably higher than the earth's highest mountains. If the ascent of mountains could be arranged in some such manner, it would not be difficult to reach the highest summits of the Asiatic mountains. But as long as it is not practicable to use balloons in ascending mountains, one must be satisfied with the means of ascent which are to be had. One of the most practical and simple means which the traveller could wish, for facilitating the ascent, is to be found at the very foot of Mustagh-ata, where the Sarikol Kirghiz of the Kara-teit and Neiman tribes pasture their great yak herds. Among these strong and tenacious animals, inured to the rarefied air, one only needs to choose a few of the best, in order to be helped a good piece on the way. In the four ascents which I made I always used yaks, which, without any apparent exertion, climbed as high as 19,500 feet, so that even at this considerable height, where the snow lies deep, I did not feel any loss of strength worth mentioning.

During February and March, 1894, I rode over Russian Pamir, and arrived in the middle of April at the western foot of Mustagh-ata, where I was received in a very friendly manner by the Kirghiz. We planned a complete campaign against Mustagh-ata, and we intended to do everything to conquer the giant. We were to lie in ambush, watch for an unguarded moment—that is to say, for favourable weather—and then make the attack. Since the distance from the valley to the summit is very great, it was decided to plant a depôt as high up as possible, from which we could reconnoitre and advance.

On the morning of April 17, therefore, a picturesque alpine caravan stood waiting outside of my *yurt* (tent). The caravan was composed of six weather-beaten Kirghiz clad in warm sheep-skin great-coats, and with staves in their hands, nine large black yaks, and two sheep. The

yaks were laden with necessary provisions, spades, crowbars, axes, ropes, fur overcoats, blankets, a photographic apparatus, etc. The more delicate instruments (thermometers, psychometers, boiling-point thermometers, aneroids, and field-glasses) were carried in satchels by the Kirghiz. The other yaks were saddled, and we mounted, and began a slow march up the mountain in a south-south-east direction. The yak is guided by a rope run through the cartilage of the nose, but, however vigorously one protests, he goes along as he himself pleases, with his nose to the ground, and his heavy breathing sounds like the puffing of a distant steam saw-mill. We passed a glacier-tongue (the first one), whose light green ice shone on the slope; below its terminal moraine lies a block of gneiss broken in two. This track of country is called "Kamper-kishlak," or the old woman's village (*kishlak* properly means "winter pasture," as distinguished from *jejlau*, which means "summer pasture"). Tradition tells us that when the Shah of Shugnan waged war against the Kirghiz, they all fled except an old woman, who hid herself between the two halves of the gneiss-block, and thus escaped. The ascent is very steep; nowhere is there to be seen as yet any solid rock, but the whole ground is covered by gneiss blocks and ancient moraine heaps.

Towards evening, at a height of 14,500 feet, we reached a snow-free place lying between moraines and protected from the wind. Here we encamped. With the aid of felt mats, alpine staves, and ropes, we made a temporary bulwark on the south side of the camp. Later in the evening a Kirghiz arrived with two more yaks laden with *tesek* (yak-dung), and a large fire was kindled in the open, where we sat down to make a meal on mutton. Then the moon rose behind the mountain, surrounded by a resplendent corona. The fire was allowed to go out gradually, and we slept calmly under the bare heavens, on the mountain of Hasrett-i-Musa.

The next day, April 18, was unfavourable. The sky was covered with clouds; it was cold and windy; but we decided, nevertheless, to make an attempt to proceed. We were to take only three yaks with us, for the Kirghiz preferred to go on foot. In sharp zigzags we worked slowly up the slopes, which became steeper and steeper. The yaks are very surefooted, but rest often. When the clouds at intervals cleared away, the most glorious pictures presented themselves to our views. The whole of the Sarik-kol valley lay below us, spread out like a map. To the north we could see Little Kara-kul and Balun-kul; to the south-west, the mountain chains of Murgab; and deep down below us, on the western side, the grave of Chum-kar-kashka-Bater, on a height that from the valley looked like a great mountain, but from here like a little hill.

When we arrived at the northern marginal rocks of the Jam-bulak glacier, we stopped to make a few observations. We were here at a height of 16,000 feet, and had, therefore, all the mountains of Europe

beneath us. Proud as a king, the glacier comes forth from its castle-gate, a deep and broad fault (*Grabenversenkung*), which divides the mountain into the two above-mentioned parts, and which throughout its entire length is filled by the colossal masses of the glacier. In three places this glacier passes steep falls (*Sturz*), causing whole systems of deep, gaping, transverse crevasses. Between these are cubes or pillars of crystal-clear though partly snow-covered ice, which, however, through ablation are gradually rounded off, and in the lower parts of the glacier-tongue, form a chaos of pyramids, which make this glacier very difficult to cross. Afterwards I visited it several times,



THE FIVE CULMINATING PEAKS OF MUSTAGH-ATA, FROM THE SARIK-KOL PASS.

but could never succeed in getting more than half-way over it. Its left half is so cut up by crevasses that there is no possibility of making one's way across it. Where the glacier issues from the rocky passage formed by the fault, it spreads out to double and treble its original width, and becomes in the same proportion thinner. But even here I measured crevasses as deep as 60 feet, from which may be inferred that the thickness of the ice in the rock-passage itself must be enormous. From the point where we were now, we had a good opportunity of observing the contour of the whole glacier-tongue, and the longitudinal, transverse, and marginal crevasses which, like a net, cross and recross its surface. The lateral and terminal moraines which now form high walls around the ice-margin, the old moraines which have long ago been

deserted, bottom-moraines on which the glacier formerly stood, the glacier-brook with its steel-blue silt,—all could be seen very plainly.

When we had reached a height of about 15,150 feet, where water boiled at 82.53° C., and where the temperature sank to 4.5° C. below freezing-point, we were overtaken by a *buran* (snowstorm), so violent that we were obliged to lie still for several hours before we could, even with the greatest caution, begin the descent through the fresh snow-drifts which now treacherously concealed the ground.

We remained two days more at the *dépôt*, but the weather now became very unfavourable, and the snowstorm raged even down in the Sarik-kol valley. I had, besides, contracted inflammation of the eyes, which compelled me to hurry in forced marches to Kashgar, where I was received by the Russian consul, Nikolai Feodorovich Petrovski, and his wife with the same extraordinary hospitality as they showed me four years ago. During the two months which I spent with them, I frequently had the pleasure of again seeing Mr. George Macartney. The first unsuccessful attempt to ascend Mustagh-ata incited me to revisit the mountain, and I therefore decided to devote the whole summer to a thorough exploration of it. Thus on June 21, with a little caravan, I marched back to Sarik-kol *via* Kok-moinak and Tagarma, and at Su-bashi engaged Kirghiz and yaks and hired a Kirghiz tent (*y*).

We spent two weeks at Little Kara-kul and Bassik-kul, which tract of country I mapped with topographical instruments to serve as basis for our operations on future excursions. After this work was done, we broke up and started off in a south-easterly direction. For ten days we explored the north-western slopes of the mountain, together with the five mighty glaciers which flow down in this direction from the central firn district; and when this was done, we established a permanent *dépôt* at the height of 14,400 feet, below the place where we tented in April. From this point we had the most glorious view of the Sarik-kol valley and the nearest mountain chains of Pamir, and in our immediate neighbourhood three mighty glacier-tongues were melting in the sun. The hospitable Kirghiz supplied us with provisions, which very much facilitated our sojourn in this barren and sterile neighbourhood, among ancient moraines long ago deserted by the ice.

From the temperate summer and smiling shores of Kara-kul, we had come up into a real polar winter, and near the end of July we had daily snowstorms for a whole week, and the weather seemed to present insurmountable obstacles to an ascent. If it did not snow, it hailed, and if clear weather, there was a penetrating and icy north wind which, higher up on the mountain, drove up the firn snow in thick white clouds; and if it was calm and sunny for a little while, we hoped in vain for a fine day, for in a quarter of an hour the sky would again be

covered with clouds, and the hail would be lashing the sides of the mountain. Frequently the yaks stood saddled, the instruments and satchels were divided among the carriers, and we were just about to break up, when the storm would come down upon us and annihilate the plans of the day.

In the beginning of August the weather was glorious, and on the 5th we prepared for an ascent the next day. The day had been fine, but as twilight came on, the usual hail and wind began. The mountain, which with its white fields of snow and ice lately shone in dazzling



SARIK-KOL PLAINS.

splendour, was again enveloped in thick clouds, and towards evening Æolus danced a mad ring-dance around one of his highest thrones. On the 6th, however, our hope did not disappoint us. With five Kirghiz and seven yaks we broke up before sunrise, and started up the slope situated on the right or north side of the Jam-bulak glacier, which flows to the west—that is to say, the same place where we had failed in our ascent in April. After an hour's climbing, Mount Rosa (15,310 feet) was beneath us, and after still another hour we had ascended higher than Mount Blanc (15,930 feet); but full two hours were passed before we reached the height of Mount St. Elias (18,200 feet), and then we strove to climb to the height of Kilima Adyaro (19,800 feet), and with great exertions we succeeded in nearly reaching this altitude.

The snows were very favourable, and did not hinder the ascent in any large degree. At the height of 16,350 feet we passed the snow-line. The snow lay here in small fields, interspersed with patches of gravel;

then a continuous field, which, 650 feet higher up (perpendicular height), was covered with a thin crust, and was packed so hard that the men's leather boots left no marks. The snow became deeper the higher up we came, from a few centimetres to one and two decimetres; but at the highest point we reached, it lay as yet only 15 inches deep. On the right lies the Jam-bulak glacier, between its two perpendicular rocky walls of gneiss and crystalline slate.

During the ascent three of the Kirghiz fell behind, because they suffered from a splitting headache, and with the two others I continued till I reached the height of 19,450 feet, where the lie of the ground became different. A very steep slope, which higher up gradually developed into the flattened cupola of the summit, stretched up before us, and was covered with deep snow, whose surface was crossed by fissures and faults (displacements or dislocations?), showing a tendency to form avalanches. The Kirghiz warned me, and with due cause, not to set foot on this steep slope of snow, which every moment threatened to fall, for the yaks with their great weight might easily cause an avalanche, which would surely be fatal to us all. The men said that, from the valley below, they had sometimes seen avalanches. The snow whirled up in great clouds and swept down the slopes. When it stopped, it seemed to be changed to ice at the bottom. Since the day was nearly at an end, I gave orders to return. We had learned that *one* day was not enough to reach the distant summit, and that it was therefore necessary to establish still another depôt.

During the following days we explored three of the largest glaciers, Chal-tumak, Tergen-bulak, and Chum-kar-kashka, which all flow to the west, *i.e.* towards the Sarik-kol valley. On the left or south side of the first-mentioned glacier, we attempted a new ascent on August 11. The night had been rather cold (4.8° C. below zero), and in the morning thin layers of ice lay between the stones in the glacier-brook, which had now shrunk down to an insignificant rill, more muddy than usual, since the clear brooks from the melting snow and ice in higher regions, and from the surface of the glacier, were probably frozen. The weather was, besides, especially favourable. Not a cloud was to be seen; only a light breeze was stirring, which gradually died away.

On the whole, the surface-forms of the ground are similar to those of Jam-bulak; at Chal-tumak we also find a mighty glacier, whose bed is in a passage out deep into the mountain. Here the whole of the firn district lies plainly before us, and above it rises Mustagh-ata's highest summit, clad with steel-blue ice, which stretches down in all directions over the mountain-slopes, between the glaciers, in broad, thin, and still thinner tongues. Quite near the verge of that precipice which rises perpendicularly from the surface of the Chal-tumak glacier, the slope is bare and strewn with fine detritus, forming a ridge,

which runs upward in the form of a gradually tapering wedge, and disappears, at the height of 15,600 feet, under the ice. This scale of ice was covered near its lower edge with compact snow from 3 to 5 inches deep, which kept the yaks from slipping, although the slope here had an inclination of 24° .

We had an opportunity of witnessing a stately glacier-avalanche from a protruding part of the ice which runs from the right into the Chal-tumak glacier, and whose obtusely broken tongue, smooth as polished steel, gleams in lines ranging from light green to marine blue at a height of 1000 to 1300 feet above the surface of the main glacier. At this height it forms a so-called hanging glacier. Slowly gliding down the mountain-side, it gradually projects over the verge of the precipice, till enormous fragments of the overhanging mass of ice break off and fall into the chasm below, and are dashed against the protruding spurs of rock and ground to fine white powder, forming, on the surface of the main glacier, a conical heap as white as snow, although some detritus has been brought with it in the fall. Here the ice-powder again melts together, and forms a tolerably clear ice-stream, which, on the back of the main glacier, slowly glides down towards the valley. It is a regenerated glacier—a parasite glacier.

We had not gone far on the ice-sheet before we went astray among the transverse crevasses of the tongue of armour-ice which crossed our way. To begin with, these crevasses were only a foot wide, but the higher we ascended, the wider they became; but they usually tapered out on both sides, so we could frequently go around them. The longest were crossed on snow-bridges. Most of them, however, were not discovered till the yak plunged his fore legs into them, but he always skilfully and agilely raised himself by pressing his nose against the opposite edge. Here the depth of the crevasses did not exceed 32 feet.

Higher up the ground became less dangerous, the crevasses being fewer and narrower; but the depth of the snow increased to 16 and 20 inches, and the yaks forced their way slowly through the drifts like snow-ploughs. Thus for some time we ascended on steadily rising ground, and hoped to find a passage between two enormous protuberances of ice, whose perpendicular clear surfaces shone in the sun. We were getting on very well, when all of a sudden the first yak disappeared in the snow, all except his horns, his right hind leg, and the pack on his back, which still stuck up through the snow. He had broken through a crevass in the ice more than a yard broad, and was held up only by his pack, which protruded over either edge of the hole in the vault of snow. Fortunately he lay still, and with the help of ropes and a couple of the other yaks, we at last succeeded in pulling him out. The crevass was only 25 feet deep, and through the opening there gleamed a dark blue refulgence. The walls were of clear ice, and the bottom covered

with caved-in snow, and from the under side of the treacherous vault there hung ice stalactites, formed by dripping water on warm, sunny days. These crevasses are, however, surely shallow, compared to the whole thickness of the ice covering, which, judging from isolated, broken off ice-masses higher up, must be enormous.

After still another yak and a Kirghiz had come near disappearing in a crevasse which crossed the one above mentioned, it became clear that we had come to very dangerous ground. The worst of it was that the Kirghiz had discovered, in our immediate neighbourhood, a crevasse which, according to their description, was three "yak-lengths" broad; and I could see myself how it stretched from the glacier-passage to one of the ice-precipices, and totally shut off our way. We had taken with us tents, rugs, and provisions; but under such circumstances there was no object in spending the night here, and we consequently returned to the camp, after having reached the height of only 18,750 feet. From this height the gigantic glaciers resembled narrow white bands, disappearing when compared with the tremendous masses of ice which covered the central part of the mountain.

Furnished with complete equipments for two days, and accompanied by six Kirghiz, my Sart servant, Islam Bek, and ten yaks, I again attempted, on August 16, to ascend Mustagh-ata at the same place where we had tried on April 18 and August 6. When we reached the snow-line, we followed our old tracks, which formed a guarantee against accident. The way could be clearly seen, winding in zigzags along the edge of the right-hand rocky wall of the glacier-passage. Since at first the snow-covering was thin, our old footprints were melted into large round hollows, at the bottom of which the detritus lay bare. Higher up, every footprint was filled with blue-green ice; and still higher up, covered with a crust of snow as thin as paper. In some places the track was partly obscured by drift-snow, but never so much so that it could not be discovered and followed, as a safeguard against lurking dangers. Thus there had been no snowfall of any consequence here for the whole of ten days.

When we reached the point where we turned back the last time, we halted and pitched the *yurt* on the slope. To begin with, all of us felt quite well, and we made a large fire of *tesek*, which gave out a good deal of warmth, but filled the tent with suffocating smoke, which made our eyes smart, and but slowly sought its way through the open entrance. After a while, however, the Kirghiz began to complain of headache, and two of them were so bad that they were obliged to return. Among other symptoms which increased in all of us during the night and towards morning, may be mentioned—continued ringing in the ears; slight deafness; faster pulse and lower temperature of the body than under usual circumstances; absolute sleeplessness, probably on account of the

headache, which became unendurable towards morning; and now and then small attacks of dyspnoea. The Mussulmans groaned constantly the whole night, as if they had been stretched on a rack; the furs seemed fearfully heavy and oppressive; the lying posture makes breathing more difficult, and one can plainly feel the heavy throbbings of the heart. When the tea and bread were served, nobody ate or drank, and when night came down upon us, the Kirghiz became rather gloomy. Darkness did not last long, however, for the full moon soon rose in dazzling splendour in the black-blue heavens, and called forth the



MUSTAGH-ATA FROM THE NORTH, WITH THE GORUMDE GLACIER.

most wonderful and fantastic effects of light on the convex fields of snow, around the deep glacier-passage and in the inaccessible firn district.

The night was desperately long. We all suffered from the agonies of mountain sickness, and gasped for more air. We were fearfully cold, largely on account of a violent south-west wind, which sprang up after midnight, for the minimum temperature fell only to 12° C. below zero. At last the sun rose and lit up our misery; but the coming day was not at all favourable. A nearly hurricane-like wind swept the sides of the mountain, and blew up thick clouds of flour-fine snow about us. Only the nearest surroundings could be distinguished, and to attempt an ascent on such a day would have been to go to certain death. I saw at once how impossible it was, but still clung to the hope that the

weather might clear up towards noon. We therefore waited patiently in the little windy tent, into which the drift-snow sifted in thick clouds from all directions, making it impossible to keep up a fire; but about noon it was quite clear that the day was lost, for the storm steadily increased in fury. I therefore gave orders to break up. Three of the Kirghiz had to answer for the tent and the burdens. The rest of us wrapped ourselves up in everything we had, and down we went with the speed of a whirlwind through the snowdrifts. The yaks actually cast themselves headlong into the snow, dived through the drifts with the agility of dolphins, and, in spite of their great weight, never slipped or stumbled a single time. One sits in the saddle as though on board a jolly-boat pitching and tossing in a high sea, and must blame himself if he is not strong enough in his knees to keep in his saddle. Frequently one must throw himself backwards and lie with his back against that of the yak. It is necessary to use every muscle in the body to balance one's self in harmony with the yak's unexpected but agile and ingenious manœuvres. Finally we reached the depôt, where we enjoyed a much-needed rest, but felt during the whole of the next day like convalescents after a protracted illness.

The functions of the body are, as mentioned above, dependent upon the physical exertions and the rarefaction of the air. In this respect, the pulse is more sensitive than the temperature of the body. During our wanderings on Mustagh-ata, I made several physiological observations on the Sart, Islam Bek, from Osh (43 years old); the Kipchak-Kirghiz, Jehim Baj, from Shugnan (40 years old); and on myself (29 years old), and some of these results may be of interest.

		Temperature.	Pulsations.	
		36° Cent.	
July 28, 10 p.m.	Myself	98	13,550 feet height.
	Islam	36.4°	92	
	Jehim	35.6°	66	
July 29, 10 p.m.	Myself	88	14,100 " "
	Islam	36.3°	92	
	Jehim	35.3°	74	
Aug. 5, 9 p.m.	Myself	88	14,100 " "
	Islam	36.4°	90	
	Jehim	36.6°	84	
Aug. 6, 12 m.	Myself	86	17,200 " "
	Jehim	35.6°	82	
	Myself	94	
Aug. 11, 2 p.m.	Islam	86	18,600 " "
	Jehim	35.9°	84	
	Myself	106	
Aug. 16, 8 p.m.	Islam	98	19,500 " "
	Jehim	36.65°	116	
	Myself	102	
Aug. 17, 9 p.m.	Islam	82	14,100 " "
	Jehim	36.72°	84	

Although there are many exceptions, it seems, from the above table, that the general rule is, that the temperature falls and the pulse increases the higher one goes. With me, the temperature of the body usually varied only $\frac{1}{2}$ ° C., while my pulse remained tolerably

even, which doubtless depends upon the fact that I avoided every unnecessary movement of the body, while the men, on the contrary, sometimes went on foot. The greatest variation in the pulse took place in the Kirghiz, Jehim Baj. At the height of 13,550 feet he had 66, and at 19,500 feet, 116 pulsations; that is to say, the pulse increased 50 beats in ascending 6000 feet. The irregularities in the numbers of the table depend, without doubt, upon several outer circumstances—as, for instance, more or less lively movements of the body, individual sensibility to the rarefaction of the air, temporary indisposition, and the like. I always made the observations, however, after a rather long rest, so that shortness of breath, over-heating, and the feeling of fatigue had had time to disappear entirely.

The four ascents of Mustagh-ata taught me, firstly, that one day is not sufficient to reach the summit, to which the distance from the western foot of the mountain, even on a plane, is considerable; and, secondly, that to spend the night at a height of from 19,000 to 20,000 feet is not practical, because the bodily strength thereby speedily decreases, and a distressing headache is brought on. The best way to attain a happy result (although I unfortunately had not time to try it, on account of the lateness of the season, and was also hindered from doing so by the unfavourable and windy autumn weather) is, without doubt, to begin the ascent as early as two or three o'clock on a calm, fine morning in the beginning of July, from a depôt at the height of from 15,000 to 16,000 feet, and to accomplish it all in one day. In this case, yaks must be used to the greatest possible height, and when they cannot go higher, they must be left, and the rest of the ascent must be made on foot. In descending, the yaks may be used from the place where they were left on the way up. The prospects of reaching the highest summit of the mountain (that which rises immediately south of the Jam-bulak glacier's firn district) are, however, according to my opinion, very small; nay, I might even venture to say that it is impossible. The yaks will probably not be able to climb higher than 21,000 feet, for here the snow becomes 2 feet deep and more, and here the ice-covering forms enormous blocks and protuberances, between which broad and deep cracks, often concealed by snow, cross and recross the ice. It is impossible to force one's way with yaks over such ground; here one must depend upon his own strength. Many cracks are too broad to step over, and special appliances must be used, such as glacier-ladders. But even if these and other necessary implements are made as light as possible, their weight will, nevertheless, be very much felt at this height. But the northernmost summit of the Mustagh-ata mass (situated on the north side of the Jam-bulak glacier's firn district), which is, however, considerably lower than its neighbour, may probably be reached. The character of the ground, at least, does not here offer any insurmountable obstacles. Besides, if one succeeds in reaching the

neighbourhood of this summit, it is not impossible that a passage might be found over the glacier's firm district to the highest summit, which lies to the south of it. But in making such an ascent, one must take into consideration enormous distances which cannot be travelled in one day, in addition to the height to which one must climb, the snow, and the unfavourable character of the ground in general.

Under all circumstances, in order to make a successful ascent, one must start from the Sarik-kol valley in the west, where one already finds himself at a height of from 12,000 to 13,000 feet, and in which direction the slopes are least steep. From the east, south, and north the mountain is inaccessible.

If an experienced mountaineer like Conway, with a suitable companion and a hardy and experienced Swiss guide, were to make the attempt, he would surely reach a very considerable height, nay, perhaps even the northern summit. But even a Swiss guide, no matter how experienced, will here find himself in strange surroundings, for Mustagh-ata's summit rises 9000 feet above the highest mountain of Europe.

MODERN GEOGRAPHY, GERMAN AND ENGLISH.*

By H. J. MACKINDER, M.A.

THIS is a memorable year for English students of geography. We have entertained in London for the first time a great gathering of our foreign colleagues, and have presented to the British public the unfamiliar spectacle of a geographical meeting, in which scholars and professors were as prominent as explorers. As a nation we may justly claim that for several generations we have been foremost in the work of the pioneer; nor need we view with dissatisfaction our contributions to precise survey, to hydrography, to climatology, and to biogeography. It is rather on the synthetic and philosophical, and therefore on the educational, side of our subject that we fall so markedly below the foreign and especially the German standard, and it is for this reason that we may regard the Sixth International Congress as a noteworthy object-lesson for English geographers and teachers. The time seems, moreover, to have been ripe for some such stimulating influence. To indicate a few signs only of rising courage among our geographers, and of sympathy on the part of the public, I would draw your attention to the institution of afternoon meetings in Savile Row for the discussion of technical questions, to the success of the new Geographical Journal, notwithstanding its geographical as opposed to merely "adventuring" flavour, to the recent formation of a geographical association of Public Schoolmasters, and to the demand for addresses on the teaching of geography on the part of the local branches of the Teachers' Guild. Facts are reminding us once more that the lapse of a certain time is essential to the rooting of a new idea, and we may thank the geographical veterans of 1869 for sowing seed the fruit of which we are now harvesting. That I am not alone in my interpretation

* Presidential Address to Section E (Geography) at the Ipswich Meeting of the British Association, September 12, 1895.