THE SHAKSGAM EXPEDITION, 1937

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THE main object of the expedition to be described in this paper was the exploration and survey of the unexplored country in the vicinity of the Shaksgam river, which is situated somewhere on the undemarcated frontiers of Ladakh, Hunza, and Sinkiang. Our principal interests lay firstly in the large unknown region of high mountain country which lies north of the main Asiatic watershed, between the Sarpo Laggo valley, and the Shimshal pass, and bounded on the north-east by the Shaksgam (about 1000 square miles in area); secondly, in the glacier system lying to the north and north-west of K2; thirdly, in the portion of the Aghil range, west of that explored by Professor Mason in 1926. The two outstanding problems of this last area were the exploration of the lower reaches of the river discovered by Mason and named by him “Zug Shaksgam,” and the discovery of its outlet; and the fixing of the geographical position of the Aghil pass. This being the fiftieth anniversary of Sir Francis Younghusband’s journey across Asia we had an added incentive to visit this famous pass.

When, in September 1936, I obtained permission from the Government of India to undertake this project, I had intended that the party should consist of Tilman and myself with two Indian surveyors to work near our base and form a nucleus of accurate work to which we could attach our long, less detailed traverses. But on closer examination of the problem involved, I decided instead to invite Michael Spender to undertake the work of this detailed survey. Fortunately he was able to accept. The Survey of India most kindly contributed to the funds of the expedition. I also asked J. B. Auden, of the Geological Survey of India, to accompany the party, to assist in the exploratory work and to carry out as much geological investigation as he could. Seven Sherpa porters were recruited from Darjeeling, and owing to generous contribution to the funds of the expedition, we were able to engage for permanent employment four men from Baltistan. Apart from coolies employed temporarily as far as our base in the Sarpo Laggo, this completed the personnel of the party.

The next thing to be decided was how to tackle the problem of getting to the Shaksgam. Apart from attempting to reach it from China, three alternatives were open to us: firstly, to cross from the Karakoram pass to the head waters of the Shaksgam, and make our way down over the difficult glacier trunks which had defeated Mason’s party in 1926; secondly, to cross the Shimshal pass early in the spring, and force a route up the lower gorge of the Shaksgam before the river became too high; and thirdly, to cross the main Karakoram range from the Baltoro glacier. The first two alternatives would probably have involved considerable difficulties with the river even early in the year, and would have rendered us liable to be cut off by the summer floods until late in the autumn. Besides which, the journey either to the Shimshal or the Karakoram pass is very long and costly, particularly early
in the year when the routes are not officially open. The difficulties involved by the third alternative were of a purely mountaineering character, and though we were likely to have considerable trouble in getting several tons of stores and equipment over a difficult glacier pass early in the year, I chose this route.

Our rough plan of campaign then was this: to reach the Baltoro glacier by the end of May; to cross the watershed with sufficient food to last the party for one hundred days after reaching our base below the snout of the Sarpo Laggo glacier; leaving a dump there, to cross the Shaksgam and spend as much time in the Aghil range as was possible without being cut off by the summer floods; and to return to the Sarpo Laggo about the middle of July and spend the remaining two months working on our other two objectives.

The chief difficulty which had to be faced in working out details of the above plan was the fact that, once across the main Karakoram range, the party would have to be entirely self-supporting for the whole period of its stay there—nearly three and a half months. This, and the enormous expense of transporting each effective load across the watershed, necessitated the rigorous exclusion of every ounce of superfluous equipment, and very careful rationing and the rejection of all delicacies which did not carry the maximum food value, or which interfered with a proper diet balance. Our food was based on a variety of Arctic sledging rations altered to suit the different conditions of supply and transport. We took a .375 rifle with us, but although we succeeded in shooting a good deal of meat, we did not rely upon it as a source of supply.

We left Srinagar on May 5 and crossed the Zoji La to the valley of the Indus. Although that pass is only some 11,500 feet high it was still under deep snow and impassable for animal transport. In order to avoid avalanches we had to cross it with our twenty-five local coolies at night. We reached Skardu in Baltistan on May 18. Here we obtained supplies of rice, sugar, tsampa, kerosene oil, salt, ghee, and blankets for the coolies we were to employ above the Baltoro glacier. We were assured by the local authorities that as there had been a famine in Askole we would be able to obtain any quantity of flour at that village and at very cheap rates. Without being able quite to follow this curious reasoning we relied on the statement, as we were able thereby to avoid the expenditure of several hundred rupees in transporting two tons of flour from Skardu. The remaining five days' journey to Askole introduced us to three of the local methods of river crossing. The quietly flowing Indus was crossed in a huge wooden barge (said, I believe, to be the identical boat used in the days of Alexander the Great) which had accommodation for ponies; the fierce Braldu stream was negotiated on a raft of inflated skins—it was a sickening sight to watch the survey equipment and the load containing the treasury being swept down the rapids on this inadequate craft; and higher up, the river was spanned by two of those V-shaped rope bridges which I think are peculiar to these parts. This horror we were able to avoid however by a sensational rock climb along the face of the cliff which the bridges were designed to circumvent.

We reached Askole on May 24. Spender and Auden went ahead from here to carry out a large-scale survey of the snout of the Biafo glacier, in order to compare its present features with those that Auden had observed when he
Peak above Trango glacier

Skyang Kangri (Staircase) from Peak 6350 above K2 glacier
K2 from Peak 6350

Phot. H. W. T.

Porters at high camp above Trango glacier

Phot. E. E. S.
had visited the glacier in 1933. On his return to Askole, later in the year, he repeated this work and so was also able to obtain some data about the behaviour of the glacier during the summer. Meanwhile Tilman and I bought and bagged two tons of flour, the great bulk of which was to be eaten by the coolies who carried it towards our base, and recruited 104 men from the neighbouring villages for transport work on this final stage of the journey. We agreed to pay them a rupee a day each and to give them bonuses according to the number of stages they were taken. We left Askole with this huge caravan on May 26. The whole success of the expedition now depended upon how far we could get these men, and it was essential that they should be induced to go as fast as possible, for in its present form the party was consuming 230 lb. of food a day and each extra day which was occupied in crossing the range meant that we would have a week less for our work in the country beyond. Moreover the cost of employing such a large number of men was considerable.

Having made a late start on the 26th it took us three marches to reach Paiju, below the snout of the Baltoro glacier. Being on a path the men went well, and except for the fording of the stream coming down from the Panmah glacier we had no trouble. But the weather was bad and we had a great deal of rain, which, besides threatening to spoil our all-important flour supply, which we could not protect while on the march, was depositing an alarming amount of snow on the range we were about to cross. Spender and Auden caught us up at Paiju, having completed their job on the Biafo glacier. Here our troubles began. On reaching Paiju, Tilman and Sen Tensing went down with a fairly severe fever; we could make no accurate diagnosis of their complaint and it was difficult to know what action to take. Auden volunteered to stay with them, and to deal with any situation that might arise, and it was decided that Spender and I should go ahead with the rest of the party and attempt to get them across the range. We had no idea how far the Baltis would be prepared to go nor what conditions we were likely to find. If they were to desert us early we would be obliged to relay all the stuff over ourselves, which, even if it were possible, would take several weeks of hard work. In any case the party we left behind would have ample time to catch us up, unless the fevers proved to be serious. It was agreed that, if we had no news of them by the time we had got all our food and equipment across the range, I should return to decide what was to be done, leaving Spender to begin his preliminary work on the Sarpo Laggo glacier.

Only one route across the main watershed between the Shimshal and the Karakoram passes, the western and eastern extremities of the range, had been used by Europeans. This was the Muztagh pass which had been crossed by Sir Francis Younghusband in 1887 at the end of his trans- Asiatic journey, and which subsequently had been used only once, by the party sent into the Shaksam by the expedition led by H.R.H. the Duke of Spoleto in 1929. This pass is known to have been used prior to Sir Francis' journey by Baltis, emigrating into, and trading with, Chinese Turkistan. But it had long fallen into disuse, and an alternative pass was said to exist somewhere in the vicinity of the head of the Panmah glacier, though its exact position is not really known. Both the 1887 and the 1929 parties had encountered
considerable difficulties and it was by no means certain that it would be possible in any year to get laden men over the Muztagh pass, particularly as early in the year as we were attempting the crossing. Professor Desio of the 1929 expedition however had reported the probable existence of an easier saddle at one of the heads of the Trango glacier, which is the second tributary on the true right flank of the Baltoro glacier. We decided after much deliberation to attempt the crossing by way of this saddle. The plan had one great drawback, in that the Baltis all regarded the Trango as entirely unexplored ground, and however much we expressed our confidence in the existence of a route, we could not persuade them that they were not being led to an impasse, and they had to be driven every step of the way.

On the first day after leaving Paiju, May 29, we got involved in badly broken ice in crossing the Uli Biaho glacier at its junction of the Baltoro, which did not improve the mental state of the coolies. On the 30th we had a very long and anxious day coaxing them over the desolate intricacies of the Trango glacier. It was an exasperating business, and our difficulties were increased by falling snow and a cold wind. Unfortunately we did not succeed in reaching a point from which we could reconnoitre the upper part of the glacier. That night we were introduced to the worst trait of the Baltis. When conditions are bad they seem to be entirely incapable of looking after themselves. They crumple up in the open, and refuse to do anything towards making themselves comfortable or protecting themselves from the wind. We were obliged to bully them into action in order to avoid deaths from exposure. The next day, after moving the party a short way farther up the glacier, Spender and I set out to look for the pass. We realized that the spirit of the coolies would only stand one high camp, and that, only if the weather improved. It was essential then to get the camp within striking distance of the watershed. But we returned at 4.30 thoroughly depressed after a long climb, having drawn a complete blank. The coolies noticed our depression and demanded that they should be paid off and sent home. Until dark there was terrific confusion, every one shouting at once, and no one listening to what was said. Occasionally blows were exchanged between the coolies themselves. The Sherpas struggled nobly to help us to deal with the crisis, but when darkness fell and cold put an end to the tornado of abuse, we had no idea whether or not the men would go any farther. Fortunately the morning of June 1 was brilliantly fine, and with promises of greatly increased bonuses the men were induced to start.

We got on to hard snow on the main glacier and made very rapid progress. We climbed a steep but easy ice-fall of a side glacier, and saw before us what we took for the proposed pass. It was separated from us by easy ground. We camped on a little plateau at about 17,000 feet, and spent a busy evening taking off the men's boots ourselves and placing them on rocks in the sun to dry, digging and levelling spaces on which they could sleep, issuing rations and fire wood (which we had brought up from the Baltoro), and helping the men to light their own fires. In this way they were persuaded to spend one more night with us. Though the night was fine, a bitterly cold wind blew which produced another crisis in the morning. We got going early however on beautifully firm snow. But higher up we found deep powder snow and though

*Up the east Surukwat valley to the Aghil pass*

*Phot. J. B. A.*
Conglomerate cliffs in the Zug Shaksgam valley

Zug Shaksgam river just below the point reached by Major Mason in 1926
we went ahead with the Sherpas and stamped a trail, the Baltis became very exhausted. When we reached the saddle we found that we were not on the watershed, but that another col lay in front of us, about a mile and a half away across a hanging glacier terrace. This proved to be the last straw. However it was still early in the day and before the Baltis arrived on the saddle we descended on to the terrace and flogged our way half the distance across it. Here we spent one and a half hours shouting back to the Baltis that they had got to come to us in order to receive their pay. These threats eventually worked. Amongst our coolie force we had seventeen men who had been recruited in Skardu. These were greatly superior to the Askole men, and even now, after a little persuasion, expressed themselves willing to come on with us. The rest were paid off. We watched them on to safer ground and made a stack of their loads. Then, carrying as much as we could, we struggled up to the second saddle from which we looked down on to the Sarpo Laggo glacier. Snow conditions on the northern side were very bad indeed. We had to work as hard as we could to get down to a rock outcrop on which to camp before nightfall.

On June 3 another relay was brought over the pass and, early on the morning of the 4th, Auden arrived bringing the welcome news that Tilman and Sen Tensing were somewhat better, and were following slowly. We sent a Sherpa and two Baltis to help them, and I escorted the first relay down the glacier to Mone Brangsa. There we found the remains of Professor Desio's camp, and probably Younghusband's, and obtained scraps of fuel. We found that a side glacier just above this place had made an enormously rapid advance. In 1929 Desio had shown it as a tiny ice stream ending a long way above the floor of the main valley; now it is a considerable tributary joining the Sarpo Laggo glacier in a confusion of ice pinnacles. Desio's photographs of the place confirm the fact of this remarkable change.

Meanwhile Spender had begun his survey. From the upper part of the glacier $K^2$ was clearly visible. It was the only G.T.S. point which could be seen from anywhere in the district, and the whole survey, with the exception of the work in the Aghil range, had to be based on it. Using a Wild theodolite, subtense-bar and plane table, he laid out a base and fixed the relative positions of a large number of prominent peaks in the district, which formed a network of fixed points for a plane-table survey. This process was repeated at intervals throughout the season, in order to keep a check on the plane-table work, and to renew the supply of distant fixed points. Azimuth determinations fixed the map with relation to $K^2$. It had originally been intended to take with us a portable wireless set in order to be able to carry out longitude determinations, but the firm to whom the order for the set had been given had failed to deliver it, and so we were deprived of the opportunity of doing this valuable work. Spender made latitude observations from time to time.

We returned to the upper camp on the 6th, and the following day went over the pass to fetch the last lot of loads from the dump on the glacier terrace. When we reached the top of the pass we saw Tilman and his porters coming up from the other side. Tilman's fever had come on again during the previous night and he was having very great difficulty in getting along. Sen Tensing had recovered but was still rather weak. Auden and I took a round of angles
from a point above the pass before returning with the others. It was a great
relief at last to have the whole party and all the stuff on the right side of the
range. By June 10 we had relayed all the loads down to Mone Brangsa.
Leaving a big dump here we took to a camp some 3 miles below the snout
of the Sarpo Laggo glacier sufficient food for our proposed expedition to the
Aghil range. Here, on the 15th, we had a day’s halt, which Spender occupied
in mapping and in determining the distances to and heights of peaks in the
neighbourhood. Auden was occupied with geological work, while Tilman
and I shot a couple of bharal. We also discharged all but four of the Skardu
men, for although we had hoped to take them at least as far as the Shaksgam,
they refused to come any farther. I sent Angtharkay and Lhakpa to accompany
them some of the way back, while the rest of the party started working the
loads up the Shaksgam. We wasted a good deal of time in doing this, but it
gave Spender and Auden an opportunity of doing their work. Also Tilman’s
fever had come on again. But when the two Sherpas caught us up we were
able to shift all the loads, which included three weeks’ supply of food, without
the tedious business of relaying.

Our difficulty now was to decide upon which of the many valleys coming
down to the Shaksgam from the Aghil mountains was the one by which Sir
Francis had descended from the Aghil pass. The largest and most obvious
valley, which cut right back into the range and which Desio had taken for the
valley leading to the pass, did not answer in any particular to the one described
by Sir Francis. Eventually, after fording the river, we selected a steep and
inconspicuous nala which we thought was most likely to be the right one.
We were correct in our choice and as we made our way up it we found plenty
of evidence of the caravan route over the pass. Some of these traces appeared
to be very recent, though for what purpose the route could now be used it is
difficult to say. We crossed the Aghil pass on June 20 and camped by a fine
lake half a mile below it on the northern side, among drifts of mauve primulas
which covered the grass slopes above the shore.

The next day Auden left us to carry out a geological traverse to the Yarkand
river, and to explore the possibilities of an alternative pass over the range to
the west. Tilman and I climbed a 20,000-foot peak to the east of the pass in
order to see into the country between it and the ranges explored by Professor
Mason. The weather was perfect. From the top we obtained uninterrupted
views in every direction. We concluded that to the east we were looking into
valleys running into the Zug Shaksgam. We secured a complete photographic
panorama. Meanwhile Spender was busy preparing the framework for his
survey of this portion of the range. From the pass several G.T.S. points
of the Karakoram could be seen. Besides K2 there were the Gasherbrum
peaks, also “Broad Peak” and “Staircase.” These provided good checks for
Spender’s range-finding and azimuth methods, and I think it can be claimed
that the position of the Aghil pass was fixed with sufficient accuracy. Observa-
tions for latitude provided an additional check.

On June 22, leaving Spender to continue his work in the vicinity of the
pass, Tilman and I, with two Sherpas and two Baltis, descended to the north,

1 The officially recognized name for Conway’s “Staircase Peak” is now Skyang
Kangri. The name “Broad Peak” has been authorised.
taking with us twelve days' food. A tremendous amount of yak dung lying around the lake had provided us with fuel, and was evidence that the pastures hereabouts are at present used extensively, probably by Turki nomads. A couple of miles below our camp we came upon a much-used shepherd camping ground. We went on down past the junction of several big valleys coming in from the west and camped at the foot of the first big eastern tributary of the Surukwat. We called this the Kharkhul Lungpa.

The following day we made our way up this valley. Our object was to find a way over into the large valley which we had seen from the top of the peaks we had climbed, and which we suspected would prove to be the lower part of the Zug Shaksgam. After going for two hours Tilman was again taken ill with fever. He stayed behind with one porter while I went on with the rest to explore the head of the valley. Farther up, it divided into two branches. I chose the left-hand one and we carried all the loads to a col (about 18,000 feet) at its head. I found that it led over to another tributary of the Surukwat. However, it commanded a fine view to the north, and I took a round of angles with the Watts theodolite. We managed to get back to the main Kharkhul Lungpa by nine o'clock, when it got too dark to travel. The next day, leaving the rest of the party here, Angtharkay and I explored the glacier of the right-hand branch. Higher up the snow was very bad, but we reached a saddle (about 19,500 feet) at one of the eastern heads of the glacier. It provided a practicable pass into the country we were trying to reach. When we got back to camp we found that Tilman and his porter had come up. This bout of fever had only lasted a day and proved to be the last of the series.

The next day we carried all the loads to the top of the pass, took a round of angles and photographs with the photo-theodolite and descended the glacier on the other side; we managed to cover some 4 miles of it before dark. Until the results of our various surveys have been worked out it is difficult to give an accurate description of the topographical details of the range we were going through, as we were in entirely unexplored country, and had no means of fixing in the field our own position, or that of anything we saw. I hope we have brought back sufficient data to be able to plot our traverses and photographs. We found ourselves in a large glacier system with numberless branches coming down from the extraordinarily complex range we had just crossed, whose general trend seemed to us to be from north to south.

After leaving the glacier we entered a difficult conglomerate gorge. As we had made a very early start we found the stream to be fordable and were able to follow its bed without being forced up on to the almost unclimbable flanks of the nala. We were obliged to cross the river about twelve times, and had to go as hard as we could to reach its end before the late afternoon floods. Even so we had to camp half a mile above its junction with a large valley running south-east to north-west. There was a plentiful supply of birch wood and other fuel. When we reached this valley early next morning we found that it contained a very large river—certainly bigger than the Shaksgam at the place where we had crossed. We concluded that this must be Mason's Zug Shaksgam. We decided to follow it upstream for a day or so and then to make our way down it. On a well-wooded spit of land at the junction of the two valleys we were surprised to find a collection of stone
shelters. As there was no possibility of grazing in the vicinity, this spot must have been used as a regular halting place on some route. But from where and to where we could not guess. Below this point the river entered what appeared to be an almost impassable gorge. Anghtharkay was sent with one Balti to see if it were possible to force a way through this, while the rest of us were exploring up the river. Each party took food for one night. The weather being fine we were able to dispense with tents and carrying very little equipment were able to travel at a great speed.

Along the floor of the valley, or on the ancient river terraces which are such a prominent feature of this country, the going was good, though we were held up from time to time by deep ravines cut into the conglomerates by side streams, and sometimes by the side streams themselves. We came upon several oases caused by springs of water. At each of these we found buildings of various types; at one was a collection of interesting dome-shaped huts. It seemed as though a little simple irrigation of these terraces would render the valley very fertile, but we did not see any traces of cultivation, recent or ancient. The problem presented by these relics of former habitation in such difficult country is a very interesting one and should be more closely investigated. By nightfall we had covered a lot of ground and fancied that we must be approaching the farthest point reached by Mason from the opposite direction. The valley had opened out enormously and we could see a lot of the surrounding country. We started again at 3.30 next morning, went several miles farther up the valley, crossed a large side nala which we fancied came down from the peaks above Durbin Jangal, and climbed a prominent spur standing some 2500 feet above the valley at the corner of a big bend in the river. We recognized several of Mason's points which now stood around us. After taking a round of angles and photographs with the Watts-Leica instrument we descended to the valley and marched up it to a point nearly opposite that which Mason had reached. The river appeared to be unfordable.

We failed to get back to our dump that day and spent a hungry night on the way back. When we reached it next day Anghtharkay reported that he had failed to find a way through the gorge. He had found however that it was possible to circumvent the gorge by climbing some 4000 feet up the steep side of the valley. Two days later we got down into a valley which flowed back into the Zug Shaksgam 4 miles lower down. We did two high photo-theodolite stations on the way. We reached this side stream at about three o'clock in the afternoon, and, badly misjudging its volume and steepness, attempted to cross it. Tilman was swept off his feet but managed to climb out on the other side. He and I held a rope across the water and Lobsang and Anghtharkay started across. A rolling boulder upset the latter, and although Lobsang made tremendous efforts to hold on to him, Anghtharkay was carried away down the river, his waterlogged load making it impossible for him to struggle effectively. It was a sickening sight, and we could do nothing to help, for had we let go of the rope Lobsang would have gone too. Anghtharkay was being crashed against the rocks with tremendous force and I expected any moment to see his head go under for good. However before this happened, by a stroke of luck, he got hung up on a rock in mid-stream, and Lobsang being safely across, the Baltis were able to drag him ashore. He was badly shaken, and
so bruised that for once he was unable to laugh at his own misfortune. But fortunately no bones were broken, and wrapped in dry sleeping-bags he recovered quickly. We had to remain where we were. It rained and snowed heavily throughout the night, and Tilman and Lobsang on the other side of the river, without any covering, fared badly. By dawn when we started, the stream was reduced to ridiculously small dimensions and we were able to make our way down the valley by continually fording it. But it was an alarming business for the rain and snow had soaked into the conglomerate cliffs which towered thousands of feet above us. Stones and boulders kept up a continuous bombardment all the way down the valley, and we had repeatedly to take cover.

When we regained the Zug Shaksgam at 9 o'clock we found that we were just below the mouth of the gorge down which Angtharkay had failed to find a route. We hurried down along the wide gravel flats as fast as we could, for our food was running short and we were by no means sure how long it would take to get back to the Surukwat, though by now we were certain that it was to there that the Zug Shaksgam flowed. After a mile the river swept against the cliffs on our side of the valley, rendering further progress along the river-bed impossible. Again we were obliged to climb 4000 feet up steep mud cliffs and traverse along above the valley. Going was difficult and complicated. We were continually being forced to perform some hair-raising feat of rock climbing on vertical conglomerate cliffs. The Baltis excelled at this as they did in dealing with dangerous rivers. Lack of water forced us to go on until long after dark, and we succeeded in regaining the river bed near an extensive jangal a mile above the junction of the Zug Shaksgam and the Surukwat. On July 2 we marched up the Surukwat and found Spender's party encamped at the foot of the Kharkhul Lungpa. They had made full use of the fine weather, and Spender had mapped an area of about 300 square miles between the Aghil pass and the Yarkand river. We returned to the pass next day and found a note sent up by Auden with the unwelcome news that the Shaksgam was in flood. He also gave a rough account of his movements since he had left us.

He had descended the Surukwat, reaching the Yarkand river on June 23; here he met two Yarkandi boys, tending a flock of goats—these were the only human beings outside our party which any of us met during the active part of the expedition. Auden's party returned to a camp at 14,000 feet up the Surukwat on the 24th. It was here that Younghusband's guides in 1887 were in doubt as to which valley to follow. Auden ascended a minor peak of 18,300 feet for geological mapping and in order to prospect for an alternative route across the range. He succeeded in effecting the crossing by way of a pass about 18,600 feet in height, and so brought his party back to the Shaksgam by way of a long wide valley which proved to be the one which Professor Desio had supposed to lead to the Aghil pass. Auden named this valley the "Skam Lungpa" because of its barren nature. He had made a compass survey of all the country he had traversed, and examined its geology as far as was possible. He then ascended the Shaksgam to a point 3 miles above Durbin Jangal, where he found fossiliferous rocks of Permo-Carboniferous age. When the food supply was exhausted he brought his party back to the
base in the Sarpo Laggo, and while his two men were bringing more food down from Mone Brangsa he continued his geological work in that part. Fortunately the bad weather beginning on June 30 had reduced the size of the Shaksgam, and neither party had great trouble in crossing; but to have protracted our stay in the Aghil range even for a few days would have been very dangerous, though there was much we would like to have done. Before leaving the Aghil pass I managed to add to our food supply by shooting five bharal. This enabled us to spend a little longer in this part of the Shaksgam. While Spender was extending his map in this direction Tilman and I went some way up the main valley to try to recognize some of the peaks which we had seen to the south-west of the point we had reached in the Zug Shaksgam. We rejoined Auden at Sughet Jangal on July 8 just as he was about to set out in search of us.

The next day Tilman, Auden and I started up the K2 glacier with two Sherpas, while Spender returned up the Sarpo Laggo glacier with the rest of the party. During the next week while all the food was being brought down from Mone Brangsa, Spender mapped the glaciers from the main range between K2 and the Sarpo Laggo pass, and we explored the country to the north of K2. We made a series of photo-theodolite stations, and there should be no difficulty in filling in that portion of the map. Tilman and I climbed an isolated peak of about 20,700 feet which commanded some of the finest mountain views I have seen. To the south of us were the colossal northern faces of K2 and other peaks of the main watershed, the entire Aghil range from the Karakoram pass to the Oprang river and the peaks beyond the Yarkand river were to be seen, and we could trace the course of the Shaksgam valley from its source to its junction with the Yarkand. The fantastic spires surrounding the Panmah glacier were clearly visible, and we saw into the complicated tangle of great peaks at the head of the Crevasse glacier, which was to occupy our attention for the next two months. Later we went up to the head of the main K2 glacier and stood in a cirque formed by the Savoia Saddle, K2, and Skyang Kangri ("Staircase"), and many unnamed peaks of equal grandeur. The north face of K2 itself is stupendous, rising out of the glacier in one continuous sweep for 12,000 feet. We were able to sit beneath it and watch ice avalanches break off 2 miles above our heads and drift away, ground into wind-blown powder long before they reached the foot of the mountain. Tilman crossed from the K2 glacier on to a large glacier which we had seen from our peak, flowing down from the north face of Skyang Kangri along the southern side of the dolomite walls of the Shaksgam. Auden unfortunately was now suffering from a fever displaying similar symptoms to the one which had attacked Tilman, and I contracted an attack of snow-blindness by foolishly stalking bharal for a whole day over a hillside covered with new snow, without wearing snow-glasses.

1 The name "Crevasse glacier," which at first sight seemed a curious description for a major glacier of the Karakoram, was, after some discussion, adopted by the expedition and incorporated in the map because of Younghusband's definite pronouncement: "The glacier we did our best to surmount I called the Crevasse Glacier, on account of the great number and size of the crevasses, which were wider and deeper and far more frequent than I have seen on any other glacier." (Geogr. J. 14 (1892) 216.)
On July 17 the whole party re-united at the junction of the Sarpo Laggo and the Crevasse glacier valleys. A stocktaking of our food supplies showed that we had sufficient for fifty-five days. On the following day we started relaying everything up the Crevasse glacier. It was a slow business at first, but if we wished to be in a position to carry out any effective survey and exploratory work from the head of the glacier, we were obliged to take with us all the supplies we had. The exploration of country, when it is necessary to work from a base which is entirely out of reach of any outside assistance, presents a very different problem from that which one is used to tackling when some sort of transport and supplies, however bad, are available. This year I found, as I had expected, that cutting ourselves off from such support for a period of three and a half months placed a considerable strain on the party.

While we were working our way slowly up the glacier, Auden, with two Baltis, went down the Shaksgam river with twelve days' food, in order to continue his geological investigations in that direction. He also took with him the Watts theodolite. Our slow progress up the glacier gave Spender plenty of time for a detailed survey of the surrounding country. Two camps took us to the junction of a number of large ice streams flowing from all directions in an amazing confusion of pinnacles and ice-falls. We called this point "First Divide." Above it we got on to dry and broken ice, and going was considerably easier. We kept to our westerly course and by August 1 had established a camp about 17 miles up the glacier. Above this it divided into two branches of about equal size ("Second Divide"). Auden caught us up here, and in three parties, with light camps, we explored the heads of these branches. Auden and Tilman were prospecting for a route which would connect up the Crevasse glacier with the Nobande Sobande and the Biafo country; Angtharkay and I were trying to find a way over on to the head of Colonel Schomberg's Braldo glacier, while Spender investigated the head of the northern of the two branches.

On August 3, while Tilman and Auden were investigating another part of the watershed, Angtharkay and I reached a saddle at the head of the southern branch. The weather was bad, and in order to see anything we were obliged to climb down a difficult ice-slope on the other side for several hours. When we got below the clouds it was evident that we were in the upper basin of the Bralu, the whole of which could now be seen quite clearly. Having got down on to one of the branch glaciers of the basin, and thus proved that the pass was practicable, we returned by the way we had come. We failed to get back to our camp before dark, with the result that I had a serious fall into a crevasse.

The following day Tilman and Auden discovered a route over the main range to the Nobande Sobande glacier, and we returned to the Second Divide on the 5th. From here the other two took a camp up a large glacier coming from the north and called by us the "Crown glacier." We hoped that exploration in this direction would tell us something about the complicated range of mountains lying between us and the Shaksgam, and also connect up with Auden's surveys in that valley. I went up the northern branch of the Crevasse glacier to establish contact with Spender's party.
I found that he had already completed the survey of the northern branch and had also discovered an easy pass leading from its head towards the north-west.

The whole party reassembled at the head of the Second Divide and we were confined to our tents for two days by a heavy snowfall. As a result of our exploration of the head of the Crevasse glacier, and in view of the immense amount of work that there was to be done, it was decided that now the expedition should be split into three self-contained parties: (i) Auden, with the four Baltis, was to cross the pass they had found and descend to the Panmah glacier and so reach Askole. This party was allotted twelve days' food and the Watts-Leica instrument. (ii) Tilman, with two Sherpas, was to accompany Auden over his pass, and from the Nobande Sobande force a route to the so-called "Snow Lake," which forms the unknown head of the Biafo glacier, and having explored that to work a way across the ranges south-west of the Hispar pass. They were to take food sufficient for twenty-two days. (iii) Spender and I, with five Sherpas and thirty days' food, were to cross the pass which Spender had found and which we expected would take us into a
Up the Sarpo Laggo glacier towards the pass from the Trango glacier

Snout of Crevasse glacier from above the expedition dump
tributary valley of the Braldu, which we proposed to explore and map, and then make our way down to the Shimshal pass mapping as much country between that and the lower Shaksgam as weather and our food supply would permit.

Auden and Tilman crossed their pass on August 11–12. From the Nobande Sobande they succeeded in reaching a point on the divide between that glacier and the Braldu. They also climbed a 19,000-foot peak on that divide, on the top of which they did a theodolite station and took a round of photographs. Auden then made his way slowly down the Nobande Sobande and Panmah glaciers surveying and doing his geological work as he went. He became involved in very difficult country and had his work cut out to reach Askole in less than a day after his food had run out.

Tilman's party having made a dump on the first pass (which he called "Faith") in a blizzard, crossed it on August 15, and that evening camped on the eastern arm of the Braldu glacier. From the peak above this pass Tilman and Auden had enjoyed an extensive view which included Conway's "Ogre" (23,900 feet), the triangulated peak whose position relative to the Biafo was very puzzling, Kanjut peak (25,460 feet), the Upper Braldu, and the Dren-mang, Chiring, Upper Panmah and Nobande Sobande glaciers, together with a mass of peaks to the south amongst which Masherbrum was very prominent. From here Tilman could make out a route to the west across the two main arms of the Braldu. If there was a pass at the head of the western arm it must lead either to the Virjerab or the Biafo; and believing it led to the latter he determined to attempt to cross it.

The next day was devoted to reconnoitring. Crossing a small saddle (subsequently called "Hope") into the western branch of the Braldu, they trudged up a long tributary glacier to the west. The saddle at the head of this was very rounded and they had to descend some way on the other side of it before being able to see anything. Clouds were rolling up from the west, but they were in time to see and recognize the strikingly bold peaks of the west wall of the Biafo, and the end of what the Workmans had called the "B.15 Range," which we had come to know so well from their photographs.

Two days later they camped on the north side of the so-called Snow Lake, the upper basin of the Biafo glacier. Tilman estimated its area to be about 30 square miles. It is remarkably flat and perhaps that might be sufficient justification for the name. A day was devoted to examining the south side and the two feeder glaciers which led east in the direction of the Nobande Sobande and Choktoi glaciers. The southern boundary of the Snow Lake is the high precipitous and remarkably straight ridge, on which, at the eastern end, stands the Ogre. The ridge terminates some 10 miles west where the Biafo proper descends in a south-easterly direction. On August 20 they traversed the Snow Lake, which at this season was mostly bare ice, and camped under the west wall of the Biafo just below where the wall turns west towards the Hispar pass. On the other side of this wall lay the Cornice glacier, which the Workmans said was without an outlet. In three days' time they found and crossed a pass over the west Biafo wall on to it. The basin of this glacier is low-lying, perhaps not more than 15,000 feet, shut in between high steep walls as the Workmans had described it, and
remarkable for the luxuriant vegetation growing in its valley within a mile or two of the head. Some 5 miles west from the Biafo it is joined by a slightly larger glacier coming down from the Hispar wall. It was disappointing to find the glacier behaving in a perfectly normal manner, and some 2 miles below the junction the combined glaciers terminated in a small grazing village in the Kushuchung valley. They emerged into the main Basha valley at the village of Bisil just below Arandu. Wishing to make quite sure that this was indeed the Workmans' Cornice glacier, they crossed, after some vicissitudes, a pass over the Ganchen range which bounds the Basha valley on the east, and thus reached the Hoh Lungma and Sosbon glaciers. Following up the Sosbon in the footsteps of the Workmans they climbed the col at the head and looked down, as the Workmans had done, upon the Cornice glacier and the pass which they had crossed from the Biafo ten days earlier.

Tilman's journey was a fine performance. In the space of three weeks allotted to him he covered a tremendous amount of ground. He managed to connect up the country which we had been exploring and the unexplored head of the Biafo with the country round the Hispar pass, and also succeeded in unravelling the complicated glacier system to the south-west. In doing this he solved two interesting geographical problems, the nature of the Snow Lake, and the supposed phenomenon of the Cornice glacier.

Spender and I spent a few days in completing the survey of the southern section of the Crevasse glacier. The section of country from which it rises is topographically one of the most interesting of the whole Karakoram range, for, besides the Crevasse glacier itself, it gives rise to a series of gigantic ice-streams such as the Hispar, Biafo, Panmah, Virjerab and Braldu. These glaciers, flowing in different directions, terminate at points which by the only known routes are many weeks' journey from each other. Only one pass had hitherto connected up any two of these glaciers (the Hispar pass, between the Hispar and Biafo glaciers, which was crossed by the Conway and the Workman parties in 1891 and 1903 respectively). It was fascinating now to be in a position to make a thorough exploration of this area and to be able to cross passes from one glacier to another almost at will. The scenery too was superb and enormously varied, the limestone mountains to the north being in striking contrast to the granite peaks of the southern glaciers. Strewn over all the glaciers which we visited we found large numbers of dead birds of many kinds, mostly belonging to the duck family, though there were also some much larger skeletons, bones of which I brought home for identification. Presumably all these birds had perished during migratory flights, though it is hard to understand why they should choose such difficult routes from Central Asia to India.

We started up the northern branch on August 13, and on the 17th managed to get all our loads over the saddle which Spender had found. We descended to a very badly crevassed glacier. The crevasses were disguised by a covering of fresh snow and as we were all carrying enormous loads (the Sherpas were carrying more than 130 lb. each) we had some difficulty in getting through. The next day we climbed a peak in order to get some idea of the country we were now in, and Spender set up his plane-table on top. The country to the north was very complicated and there was still no evidence that the
mountains in front of us formed the southern walls of the Shaksgam. The glacier we had descended plunged down in a 1000 foot ice-fall below the point at which we had camped, to join another larger glacier (which later we named the "Wesm glacier") flowing in a north-westerly direction. From our peak we had a good view of the head of this glacier which, we imagined, shared a common watershed with the Crown glacier.

But in order to get any idea of country which was still a closed book to us, we saw that we must go up to a high point on the watershed. Spender had fixed from his earlier stations several peaks in this area which were now of very great value to us. The same day we descended the ice-fall to the Wesm glacier and took a light camp up it to a point on its right bank at about 16,000 feet. From here the view down the valley puzzled us a lot. Instead of the glacier flowing gently down into the Braldu as we had expected, it ran steeply through the usual pinnacled zone, and ended abruptly 5 miles down. At first we thought that the valley below made a right-angled bend to the north, but soon we saw that it kept on its north-west bearing, and we began to suspect that it would turn out to be the nala which Colonel Schomberg had noticed joining the Braldu valley, near the snout of the main glacier and called by him "Wesm-i-Dur." This suspicion proved to be correct. On the 19th we climbed to a point, over 20,000 feet high, on the ridge bounding the Wesm glacier on the north. A large cornice on the narrow ridge made it a difficult station on which to work, but it commanded a superb view. We were able to disentangle much of the country towards the Shaksgam and also had a view down the Crown glacier. Many of the peaks we had been amongst a month earlier, including K₂, were visible, and provided a welcome check on the accuracy of the plot of our present position. To the west the great peaks of the Kanjut range provided us with new food for discussion and argument as well as a renewed vision of the incredible size and majesty of the Karakoram. North-west of us were the snow domes of the Shimshal mountains, beyond which in the blue distance stretched range after range towards Kashgar and the Hindu Kush. We were lucky enough to have another perfect day and were able to spend many hours in trying to digest this limitless tangle of country. We camped that night amongst the ice-pinnacles a few miles down the glacier and the following day reached a grassy plot by the stream of the Wesm-i-Dur, which provided a welcome change after more than a month of glacier camps.

On the 21st while Spender was plane-tabling and the rest of the loads were being brought down from the glacier, Angtharkay and I went after fresh meat. Through my own fault I failed to shoot a bharal, but managed to get some ram chikor (snow cock) instead. We saw a tremendous number of these birds throughout our stay on the northern side of the main watershed and had found several nests earlier in the year. It was rather a difficult job to shoot them with a rifle; a small shot-gun would have paid well for its transport, for there is a great deal of meat on these birds. Although we had come across any number of kyang (wild ass) in the Aghil range and in the Sarpo Laggo, we saw no trace of them in the valleys of the Braldu basin. Hares were plentiful in all the valleys below the glaciers. On the Crevasse glacier the Sherpas had caught a fox.
The ancient river terraces, extending several thousand feet above the present river level and cut by side streams into fantastic canyons, caused us a great deal of trouble, as they had done in the valleys of the Aghil. Although we gradually evolved a technique for dealing with the obstacles presented by these conglomerate deposits, it was always a somewhat frightening business negotiating them with a heavily laden party, and it took us three days of bad weather to unravel the intricacies of the Wesm-i-Dur, and to reach the wide gravel flats below the Braldu glacier, where we found a sheep pen and a shepherd's hut.

On August 26 we started up the Braldu glacier taking with us food for eight days. The first night we camped on beautiful pastures $5^{1/2}$ miles up the glacier. While stalking bharal above these, Angtharkay and I came across a pack of six wild dogs which were after the same herd as we were. In the confusion which resulted the bharal escaped unharmed. The next day we made another $5^{1/2}$ miles, and on the 28th we camped in the midst of the vast glacier basin into which Angtharkay and I had descended on August 3. The next four days were perfect and we wasted none of our precious time. Angtharkay, Lhakpa and I reached a high saddle at the head of a branch glacier on the west. It was not situated on the main watershed as I had hoped, but from it we were able to climb a small peak (about 19,000 feet) for a round of photographs and compass bearings. Again I was able to see the great peaks of the K2 range, and this time my view was extended past the Muztagh Tower to Masherbrum and the pinnacles of the lower Baltoro whose acquaintance we had made three months previously. Conway's Ogre and all its fantastic satellites were now close at hand, and seen from this angle they looked more astonishing than ever. But all this was of small interest compared with the fascinating newness of the world we were in.

While surveying on a glacier to the south, Spender saw through his telescopic alidade a large cairn. We sent two Sherpas to investigate this and found that it had been built by Tilman's party to mark the site of one of his camps. There was a letter in it, telling us of his movements up till August 18 and of his discovery of a route to the Biafo.

The Braldu glacier proved to be a very large one with a great number of branches in its upper part. The head of some of these branches were 22 miles from the snout of the main glacier. The basin of the Braldu glacier abuts on those of the Virjerab, Biafo, Nobande Sobande and Crevasse glaciers, and its bounding walls form a considerable part of the main Asiatic watershed. With the help of his survey of the head of the Crevasse glacier, and the fine weather, Spender had no difficulty in completing a detailed survey of this basin in the short time allotted to him for the task; and we got back to our dump at the beginning of September with the job finished. The still much swollen Braldu river gave us a lot of trouble before we reached a deserted village at the foot of the valley coming down from the Shimshal pass. We had now developed a good technique for crossing swift rivers: one man was tied on to the end of the rope and the rest of the party would anchor the rope at a point upstream, preferably on the outside of a bend. Leaning, if necessary, his full weight on the rope, the first man would then advance through the water, swinging pendulum-wise on the rope. The rest of the party (except for the
The Skamri peaks from the upper Crevasse glacier

Peak 18/43 M from the Snow Lake
Shamri peaks seen from the south-east across the Drenmang glacier
Phot. J. B. A.
last man), carrying the bulk of the loads, would have the safeguard of a rope stretched at right-angles across the river as well as the pendulum rope, and the last man would cross in the same way as the first. The support of the pendulum rope enables one to withstand the force of the water to an astonish-
ing extent.

The deserted village (Chikar) was surrounded by a beautiful grove of willows. The day after our arrival there, shortly after we had got down from a morning's work on the hills above, four men and four yaks came from across the river. The men proved to be Shimshalis. At first they were very scared of us, but although we had no language in common we soon convinced them of our friendliness. We managed to converse with them by means of signs, and soon learnt a small vocabulary of their words. We managed to persuade them to send one of their party over the Shimshal pass to get us some food. This man took with him the news that some Chinese had come across the Muztagh river—he had evidently taken our pig-tailed Sherpas for the leaders of our party. This startling report was carried to Hunza and thence to Gilgit.

We spent a most interesting week in the lower Braldu valley escorted by our Shimshal friends who were quite delightful. At frequent intervals down the valley we found well-watered oases which are used by the Shimshalis as winter grazing grounds. The Yarkandis, we were told, do not penetrate as far as here. A great variety of birds inhabited these lush oases, the commonest of which was the hoopoe. Half-way down to the Shaksgam is an ancient fortress known as Darband. It is built on the edge of a conglomerate ravine at a point where the main stream flows through a narrow canyon, and must have rendered the valley quite impregnable from the north. The ramparts are still kept in good repair and our guides were very particular about keeping barred the great wooden gate through which we were allowed access to the lower valley. The towers of the fortress are still used, and in one of them we found some ancient matchlock guns and drying bharal meat and skins, together with some ripening cheeses. Looking down from the turrets over the battlements and across the grim gorge in front, one had an impressive sense of the present mediaeval state of Central Asia.

While Spender was doing some high plane-table stations above the valley I rode with one of the Shimshalis down to the Shaksgam. On the way in a wood of tall willows I was shown one of the places from which salt is extracted from the soil. A pit is dug and flooded with water which is then churned up with the soil containing the salt. The mud is allowed to settle and the water is evaporated from the salt solution in slate and clay vessels. It is a long and tedious process and the output of salt is very small. This and the enormous distances to which it is carried are evidence of the value of this commodity in these parts. From the junction of the Braldu with the Shaksgam, a scene of magnificent desolation, I went some way up the great gorge of the Shaksgam and climbed a long way up its cliffs to get a view of this part of the Aghil range. The river contained an enormous amount of water, and though the cliffs of the gorge could probably be forced by a mountaineering party, it can only offer a practicable caravan route for a very few months in the winter.

We returned to Chikar and from there crossed the Shimshal pass to the grazing village of Shuijerab. The pass itself is situated in open, gently undulat-
ing country and it was hard to believe that we were crossing the main continental watershed, so great was the contrast with the other sections of it which we had visited. Just below its crest on the eastern side was a large village of some four dozen houses which is only occupied in the winter. On the western side of the pass is a lake, a couple of square miles in area, below which enormous herds of yaks and sheep were grazing on the extensive pastures. From the top of the pass we had a grand view into the country which we had been exploring. It was a fine day and Spender was able to get a good fix for the position of the pass and to round off the survey of these parts. The country to the north-east of the pass is still quite unexplored and we were sorely tempted to penetrate it by way of one of the large glaciers flowing down from its dome-shaped peaks, and to look for a pass over into the Oprang river. But by now our boots were worn out and it was doubtful too whether we would be able to get the necessary food. We consoled ourselves with the reflection that, though there were thousands more square miles of this fascinating country to be explored, we must stop somewhere if we were to get back to England during the winter, which unfortunately was imperative for both of us.

And so we went down through amazing conglomerate gorges to Shimshal where we were given a wonderful reception, and where we came to like the people of that isolated country even more than when we had first met them. The journey back from there to Srinagar by way of Hunza and Gilgit was the most varied and the most absorbingly interesting which I have made through populated districts of the Himalaya.

Exploration and survey

The party surveyed about 500 square miles, and an accurate system of heights was carried throughout the whole area. In undertaking this work Spender was set a difficult task, for it was necessary to reduce his equipment to a minimum. In dealing with this difficulty and with the remarkable absence of fixed points on which to tie his work he displayed considerable ingenuity. Again, the necessary lack of tent space compelled him to do his compilations, the inking in of his sheets, and the difficult job of transferring from one plane-table sheet to another while lying in his sleeping-bag in a tent 6 feet by 4 feet which was often shared by a companion. The maintenance of his enthusiasm for the job and of his standard of accuracy throughout the expedition was responsible for the achievement of satisfactory results.

Perhaps the three main items of interest in the field of exploration were:
(i) the fixing of the geographical position of the Aghil pass. (ii) The tracing of the course of the Zug Shaksgam river from the point reached by Mason in 1926 to its junction with the Surukwat and Yarkand rivers. (iii) The unravelling of the topographical problems at the sources of the great glaciers of the Panmah, Biafo, Virjerab, Crevasse, and Braldu.

The area explored included 75 miles of the main Asiatic watershed whose northern side was hitherto unknown.

Mountaineering

With such a vast area of unknown mountains to explore, the climbing of any of the countless peaks one sees offers little interest compared with the
enthraling business of finding one's way about the country, and crossing passes which lead from one region of mystery to another. Incidentally this occupation provides all the mountaineering one could wish for. In the course of our travels about half a dozen peaks were climbed, but all for the old-fashioned reason of wishing to see the view.

We discovered and crossed seven major passes, four of which led across the main Asiatic watershed, and also four minor passes such as that which led from the Surukwat to the Zug Shaksgam, and that which led from the head of the Biafo to the Cornice glacier.

I should like to conclude by suggesting to mountaineers who have the opportunity of visiting the Himalaya that it is not by climbing its great peaks that we can most enjoy this unique range. We have now the opportunity to see the Himalaya as de Saussure saw the Alps. When the country is known, we shall enjoy it by climbing its peaks; and, when all the peaks are climbed, we shall look for more difficult routes by which to climb them, in order to recapture the feel of adventure and to demonstrate our modern superiority.

APPENDIX I: MAP-MAKING

Michael Spender

In this expedition all members of the party were surveyors; it is only for this reason that it was possible to map so large an area. It is very seldom that the leader of an expedition considers the map as the first object of the journey; when this happens most of the surveyor's usual difficulties vanish. It should be realized that this involved for Shipton and Tilman a definite sacrifice. These two, if they were to further the map, had to give up doing throughout the expedition that which they would most have liked to do—to travel faster and cross more passes. Auden, too, threw himself with zeal and enthusiasm into map-making. Although his own science kept him very busy, he learned how to use the Watts-Leica phototheodolite; his survey of the head of the Panmah glacier (the Nobande Sobande) was the first map ever to be plotted from the Society's Watts-Leica phototheodolite.

The special problems of this area were (i) the scarcity of fixed points; (ii) the necessity for restricting the weight of all survey gear to 100 lb. or less. The only way of meeting the first condition was to make some more points. To do this by triangulation would have been out of the question. The only possibility seemed to be to use the Base method described in the paper by Nörlund and Spender, "Some methods and procedure developed during recent expeditionary surveys in south-east Greenland" (Geogr. J. 86 (1935) 321). It would be necessary to have some astronomical azimuths in any case; and observations for latitude and longitude might provide additional scientific results.

It was decided therefore to use a Wild Universal theodolite for the star work and for the base observations. By direction of the Surveyor-General this was kindly lent by the Frontier Circle of the Survey of India. The tripod and substense bar were already the property of the Society. The main work would be to fill in from these fixed points on to a plane-table. For this the Society agreed to purchase the Wild plane-table equipment. This comprised, apart from the table (53×43 cm.—a very convenient size), a slow-motion attachment to the theodolite tripod, a telescopic alidade, level, plumb-bob, box-compass, slide rule, extension arm for alidade, divided scale, dividers, and accommodation for pencils, pens, inks, etc. In fact it was a kind of travelling office, which,
contained in a robust, metal-shod box with shoulder straps, weighed 22 lb. The table was of soft wood and weighed 5 lb. I doubt whether much weight was saved by specifying soft instead of the usual hard wood; in any case a spare should be carried, for one is continually anxious lest the table should be broken in a minor slip or fall. The light tripods weigh 10 lb. each; the theodolite 15 lb. in its case; the subtense bar (Wild Precision Invar) weighs 14 lb.

The telescopic alidade is an essential part of the equipment if triangulation is to be done on the table. Without it it is practically impossible to pick up stations which have been already or which will be later occupied. It shows up moreover very promptly any inaccuracies in the points laid out by the base method. Vertical angles can be read from it to the nearest minute in the same setting as that to draw the ray. The Wild alidade has the 36 × magnification of the telescope of the Universal theodolite; angles are read through an auxiliary telescope.

The remaining part of our instrumental equipment was the Watts-Leica phototheodolite, of which there is a description in the Himalayan Journal of 1937. This instrument was as convenient and useful in the Karakoram as it has already shown itself to be in the high Himalaya.

For the plane-table I used Correctostat, an aluminium foil lined paper which served exceedingly well for plane-tabling (cf. Geogr. J. 87 (1936) 286). A roll of this, surrounded by a cardboard cylinder, was packed in an ordinary canvas case for a collapsible tripod, allowing a large area of paper to be carried without inconvenience. For the survey camera and for our private cameras Selo Fine-Grain Panchromatic Film was used and found excellent for the severe conditions of the expedition.

Immediately after crossing the pass into the Sarpo Laggo we camped on an uncomfortable piece of frozen moraine above Changtok. But this was close to a good position for the first base. When the usual range-finding observations were made, rays to all the points of this series, as well as many more for detail mapping, were laid out on the plane-table sheet. Passing from one base-end to the other I started a small avalanche, which delayed arrival at the other end. Fortunately however the weather was very fine that day. When, at that time of the year (early June), there was any wind at all at 19,000 feet, it was so unbearably cold as to make work almost impossible. K3 was visible from here, and in fact from almost the entire area: it stands out like a cathedral spire above the roofs of a provincial town.

Bases were placed later at the foot of the Sarpo Laggo, on the Aghil pass, at the northernmost station I visited in the Aghil, on the Crevasse glacier and its northern branch, in the Wesm-i-dur, at the foot of the Braldu and at Chikar. Astronomical observations for latitude and azimuth were made at the foot of the Sarpo Laggo (by our main dump) and on the Aghil pass. From above the Wesm valley we had a long-range resection from K3, Kanjut No. 1, and Dastoghil to check azimuth.

Plane-tabling was done on the 1 : 100,000 scale, a scale very suitable to show mountain detail without being too fussy. Almost every point intersected was fixed in height. Angles could be taken very quickly from the alidade, and the slide-rule supplied by the makers much reduced the work of computation. Metric notation was used, since the subtense bar was a 2-m. standard, and with the 1 : 100,000 scale arithmetic is reduced to a minimum. The sheets were inked up with 100-m. contours.

I myself never used the photo-survey equipment. The idea was always that some one else should do the survey of an enclosed area with the photo instrument: Shipton’s experience of recognizing peaks, observing to them, and
booking them was of course of very great value and saved me any anxiety lest the stations would be inadequately fixed. This is an ideal way of working and saves the enormous trouble of carrying two plane-table surveys through new country. Auden was already experienced in carrying out and booking a compass traverse, which was also a great asset. Finally Tilman's journey showed how much a few photographs and bearings can be made to produce if they can be referred to a good survey framework.

From a surveyor's point of view the weather was exceptionally good. On the whole practically no time was lost on account of weather. I should say that there was a deterioration during the first three weeks of August, but fortunately at that time the party was moving so slowly in triple-banked relay up the Crevasse glacier that I was able to get the stations I needed. The time lost in crossing moraine-covered glacier, or the absolute obstacles of pinnacled ice or swollen rivers, make the real difficulties of the region. Some vantage point to scramble to can generally be found for the least skilled climber in the worst country.

Our method of survey, to make a framework of known scale including K1 and then to find its azimuth astronomically, was tested by closing in on the Peak 18/43M. The closure was excellent in plan and height: it also identified this disputed point 23,900 feet high, which has variously been called the Ogre, Kailasa, and B.15.1

That we have a map to show is nevertheless due to the Survey of India, who took over the costs of compilation at the Geodetic Branch Office, Dehra Dun. Compilation took place on a very large board, on which was pasted a graticule of our area on the scale of the survey. Photographs of my own plane-table sections and of all adjoining work were mounted on this board. Photostations were graphically resected on it, and sheets for plotting prepared by making blue-copies of the areas concerned. These, when plotted, were again photographed and copies pasted to the compilation. The records of many surveys had to be looked into, in particular of Captain Deasy's triangulation of the Yarkand river in 1879; of Conway's journey up the Hispar in 1892; of the various journeys of the Bullock Workmans; of various journeys of Mr. and Mrs. Visser; of Major Mason's Shaksgam Expedition of 1926; and of the Italian Expedition of 1929. Colonel Godwin-Austen's plane-table made on his remarkable journey of 1861 was a perpetual reminder of the high standards laid down by the Survey of India.

The connection with Muhammad Akram's work on Visser's 1935 expedition was perfect; with Afraz Gul Khan's on Mason's expedition fair and reasonably imperfect where disagreement existed; with the Italian work very good. Serious discrepancies only occurred at the join with Afraz Gul Khan's work on the Visser 1925 expedition; that is in the Shimshal district. Here a wholesale adjustment had to be made: it is supposed that the present placing of the Hispar and Biafo glaciers, and of the glaciers and mountains between the Hispar and Shimshal, is reasonably correct.

The plotting of the photo-surveys was done by laying out the principal direction of the photographs on to the drawing paper and constructing a photo-line perpendicular to it at the equivalent focal length of the enlargement from the station. The Leica pictures were found adequate in every way for this work; heights were rounded off to the nearest 50 m. and found very consistent. The actual drawing was done by native draughtsmen who soon became very quick workers. Much office time is saved by fixing the station with the theodolite and only using horizontal photographs.

1 See "Karakoram Conference Report." (Geogr. J. 91 (1938) 134-35.)
Nevertheless travellers must always bear in mind that the completion of a survey takes about as long in the office as it has taken in the field; and that unless this office work can be done during a wintering or similar pause in the field work, provision must be made for it afterwards. Our sincerest thanks are due to the Survey of India for having made it possible to prepare our map.

APPENDIX II: PROVISIONS AND COST

ERIC SHIPTON

Food allowance per day per man

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pemmican</td>
<td></td>
<td>4 oz.</td>
</tr>
<tr>
<td>Rice, flour, and tsampa</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>Butter</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Dried skimmed milk</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Sugar</td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>New army emergency ration</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Oats</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Cheese</td>
<td></td>
<td>3</td>
</tr>
</tbody>
</table>

Vitamins A and D were taken in Crooke’s Halibut Liver Oil.
Vitamin C was taken in Hoffmann La Roche a-scorbic acid tablets.

B was taken in dried yeast.

The above ration was supplemented from time to time with fresh meat.
There was no illness which could be attributed to food or vitamin deficiency, and the party was free from septic cuts and other sores.

Summary of Cost of Expedition £

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food</td>
<td></td>
</tr>
<tr>
<td>Equipment</td>
<td></td>
</tr>
<tr>
<td>Travelling (including 3 passages to India and back)</td>
<td></td>
</tr>
<tr>
<td>Extras (hotels, tips, telegrams, meals on train, etc.)</td>
<td></td>
</tr>
<tr>
<td>Sherpas (pay, food, and travelling)</td>
<td></td>
</tr>
<tr>
<td>General transport</td>
<td></td>
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<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>92</td>
</tr>
<tr>
<td></td>
<td>118</td>
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<tr>
<td></td>
<td>239</td>
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<td>54</td>
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<td></td>
<td>156</td>
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<tr>
<td></td>
<td>181</td>
</tr>
<tr>
<td></td>
<td>£840</td>
</tr>
</tbody>
</table>

The above represents the total cost for four Europeans. The party was in the field for exactly five months.
Cost of food supplied to local coolies comes under the heading of “General transport.”

Below are the estimates which I drew up two months before leaving England:

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food</td>
<td></td>
</tr>
<tr>
<td>Equipment</td>
<td></td>
</tr>
<tr>
<td>Travelling</td>
<td></td>
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<tr>
<td>Extras</td>
<td></td>
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<tr>
<td>Sherpas</td>
<td></td>
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<tr>
<td>General transport</td>
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<td></td>
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<td></td>
<td>90</td>
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<tr>
<td></td>
<td>110</td>
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<tr>
<td></td>
<td>225</td>
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<td></td>
<td>80</td>
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<tr>
<td></td>
<td>150</td>
</tr>
<tr>
<td></td>
<td>200</td>
</tr>
<tr>
<td></td>
<td>£855</td>
</tr>
</tbody>
</table>
Until the material collected on this expedition has been examined in greater detail, it is possible only to give a brief account of the main geological features of the country. The Karakoram ranges and the region to the north were not entirely unexplored from a geological point of view before our visit. Hayden had been in the Pamirs in 1914, Mason had collected fossils from the Sa Lungpa in 1926, and De Terra had examined the Depsang in 1928. Desio carried out in 1929 a valuable geological reconnaissance over some of the region which we explored. The only results of Desio that were available to us when we left Srinagar had been published in the Journal for May 1930. His more detailed account, and his sketch-maps, given in 'La spedizione geografica Italiana al Karakoram (1929),' and published by Bertarelli in 1936, were not to be obtained in India. A geological account of my own previous traverse to Baltistan in 1933 was published in Records, Geol. Surv. India, LXIX, p. 124 (1935).

It should be pointed out that no detailed geological mapping was possible on account of the absence of topographical maps, but the data and rough plans obtained during our traverses will permit of a reasonable geological map being made when the topographical map is available.

The sequence of formations determined is as follows:

### Sedimentary rocks

- **Aghil series**: marine Triassic and Jurassic.
- **Shaksgam series**: Permo-Carboniferous, mainly marine.
- **Sarpo Laggo series**: slates, phyllites, quartzites, greywackes, impure limestones, probably of lower Palaeozoic age. These rocks become highly altered towards the south.

### Igneous rocks

- **Dolerite**: Mesozoic or younger in age.
- **Lamprophyre**: post Triassic and post granodiorite.
- **Granodiorite**: post Permo-Carboniferous in age.
- **Gneissose granite**: post Permo-Carboniferous in age.

The sedimentary rocks are disposed in a broad syncline, with an axis running N.W.–S.E. The youngest rocks, proved by their fossils to be largely Jurassic in age, occur in the form of a basin about 16 miles in length, which occupies the part of the Aghil range lying between the Shaksgam and west-Surukwat rivers. Another basin of Jurassic rocks, probably *en échelon* with that found this year, must occur along the Sa Lungpa, since Jurassic fossils were found in Mason’s collections from that river.

Surrounding the Mesozoic rocks occur successively the Shaksgam and Sarpo Laggo series. Fossils collected this year from the former support the list of genera previously found by Desio. The Sarpo Laggo series is mainly pelitic, and has been found extensively up the Sarpo Laggo and Crevasse glaciers, and along the lower reaches of the Surukwat river as far as the Yarkand. It clearly crops out in the Kun Lun range.

There is no doubt from the work carried out this year, and previously by Hayden, De Terra, Mason and Desio, that a zone of marine Tethys sediments extends for many miles along the northern side of the Karakoram range. The northern boundary of the marine facies must have been along what is now the Kun Lun range.
The whole region has been invaded by granodiorites and gneissose granites, in which the Permo-Carboniferous rocks sometimes occur as long wedges, divorced from their former associations. Lamprophyres cut both the granitic rocks and the sedimentaries, being found intrusive in the Shaksgam series and the Megalodon limestones of the Aghil series. These rocks are uncommon in India, except amongst the coal-bearing formations of the Gondwana basins.

Of great interest are the varied degrees of metamorphism shown by the Sarpo Laggo and Shaksgam series. When the Biafo glacier was visited in 1933, Auden was inclined to regard the metamorphic rocks found there as belonging to the archaean Salkhala series, which occupies large areas of Kashmir. Work this year has shown however that gradations exist from these altered rocks to the less altered and unaltered rocks of the lower Sarpo Laggo and Shaksgam valleys, and it seems probable, as believed also by Desio, that many of the metamorphosed rocks of Baltistan are relatively young.

All of us were impressed by the recent decrease in thickness of the Sarpo Laggo and Crevasse glaciers near their snouts. That these glaciers are subject to periodic changes is suggested by historical records, since at different times they have been easy and difficult of access. The Nobande Sobande branch of the Panmah was inaccessible to Younghusband in 1887 beyond Skinmang. It was so smooth and uncrevassed in 1929 that Desio was able to ski up to its head. In 1937 it was again highly broken up. The snout of the Biafo glacier has shrunk considerably since 1933, but appeared to show no seasonal retreat between May and August 1937.

DISCUSSION

Before the paper the President (Professor Henry Balfour) said: The lecture which we are going to listen to to-night is concerned with a surveying expedition in an area which is of very great importance to the Royal Geographical Society. As a result of this expedition it has been possible to fill in what was a very glaring hiatus in the map which the Society has drafted. That the expedition was a successful one you will learn very shortly, and as there is a good deal to be said on the subject I will not delay you, but will ask the leader of the expedition, Mr. Eric Shipton, to tell us about it.

Mr. Eric Shipton then read the paper printed above, and a discussion followed.

The President: Two other members of the expedition are present, the third being still in India, and I am sure we should like to hear from them. I will call upon Mr. Tilman to add some remarks.

Mr. H. W. Tilman: Mr. Shipton's account was necessarily condensed, nor is there time now for explaining the reasons for my short independent cruise. Sufficient to say that it was devoted to clearing up the misconceptions of earlier and better travellers than myself—Sir Martin Conway and the Bullock Workmans. I can assure you that for me it was a bitter disappointment to find that Sir Martin Conway's Snow Lake hardly justified its title and that the Cornice glacier of the Workmans' was not without an outlet as they had imagined. Almost thirty years ago, from this same platform, Sir Martin Conway ridiculed the idea of a completely enclosed glacier on scientific grounds, and last summer, when the discussion began afresh, he was supported by Shipton and Spender in opposition to Auden and myself. When I started I had hopes of being able to vindicate the Workmans and so confound the scientific sceptics; but, as you have heard, the Cornice glacier behaved normally, and that startling topographical phenomenon, a glacier with no outlet, has gone the way of the lost continent of Atlantis.
PARTS OF THE GREAT KARAKORAM
AND OF THE AGHIL MOUNTAINS
Surveyed by Michael Spender and colleagues
on the Shaksgam Expedition 1937
SHAKSGAM
Shipton
Some of you perhaps are less interested in mountains than in the men who visit them, so I am going to let you into a secret. I was never quite at home on this trip, for there was a man to whom slide rules and trigonometry are as intelligible as Chinese, making one of a party who thought in angles, talked in tangents, and read log tables for amusement—all this, by the way, in the metric system, so that if any height or distance was under discussion, pencil and paper were necessary to reduce it to intelligible terms. Shipton, of whom I hoped better, was the chief offender, and proved to be a confirmed "theodoliter"—a word I have coined and patented to denote the worshippers of the theodolite. True, in a moment of forgetfulness we did climb two peaks, and very good fun they were too, thanks, in the one case, to leaving the theodolite behind, and in the other the rope.

Those of you who read The Times may have noticed that we came upon the tracks of the Abominable Snowman; indeed the past season was a very favourable one for snowmen, not only in the columns of The Times but in their more usual habitat, the Himalaya. Mr. Smythe saw tracks in Garhwal which were obviously bear tracks, and in the course of a column and a half and with the doubtful assistance of several eminent zoologists, succeeded in proving that they were bear tracks.

The tracks I saw were certainly not those of bear. They were roughly circular, about 8 inches across and 9 inches deep, and the remarkable thing was that they were all on the same axis and not "staggered" to right and left as in the case of other four-footed animals. The Sherpas of course said they were the tracks of the "Yeti" or Snowman, of which there are apparently two variations, the larger which eats yaks and a smaller existing exclusively on men. These were of the smaller kind, and when I pointed out to the Sherpas that no one had been in those parts for thirty years and that he must be devilish hungry, they were not so amused as I expected. I think the pundits of the Natural History Museum must either accept the Yeti or else find us a carnivorous one-legged bird weighing several hundredweight.

To return to our journey: it was all work of great interest carried out amidst the most remarkable mountain scenery—scenery that attracts by its grandeur and repels by its desolation. Moreover we were there for a definite purpose, supported to some extent by this Society, by the Royal Society, and by the Survey of India. I hope you will agree that much was accomplished. It was due to the fact that Shipton ran the show as he has run others: lightness, mobility, and simplicity were the keynotes. If you grasp that important point you will be able to understand how we covered so much ground and how we existed in that inhospitable country for four months without seeing a village and beyond reach of supplies.

The President: I will ask the other member of the party who is present, Mr. Auden, to address us.

Mr. J. B. Auden: This is not the occasion for going into details about the geology, but I might mention one problem that was interesting us. It is well known that the Himalayas and the Alps are young mountain chains, but it is also known that there were older revolutions or periods of earth movement that had taken place before the latest Tertiary movements, and one of the things that I was trying to find out was whether there were any signs of the older movements incorporated in the younger. I think it was Professor Gregory who used the analogy of a cathedral. You might have a Norman structure with a Gothic superstructure built upon it, or you might have a Norman building pulled down and its stones used again in making an entirely new building. In the Garhwal there are certain signs of the earlier structures, but it is quite
definite that most of the structures are Tertiary. On the other hand, in the Alai and Kun Lun mountains the structures are probably old and have to only a small extent been refashioned by the later earth movements. We found in the Karakoram that the fossiliferous rocks, of Permo-Carboniferous and Mesozoic age, were laid down upon a basement of older rocks without any marked unconformity, and that both series have been penetrated and altered by young granites. These mountains would appear to show few signs of the older earth movements and to belong in the main to the youngest revolution.

A word about the glaciers. At the end of his long traverse across Asia, Sir Francis Younghusband went up the Panmah glacier in the hopes of finding an alternative route over the Karakoram range. He was unable to get beyond Skinmang because the ice there was piled up in blocks as large as houses and the glacier beyond was completely inaccessible. In 1929, Professor Desio, the geologist of the Italian Expedition, was able to use skis over a considerable part of the glacier, and his photographs show that it was remarkably smooth. When Tilman and I came over from the Crevasse glacier we thought that the Nobande Sobande branch of the Panmah, in spite of its crevassed appearance, would be a moderately easy route for me down to Askole. This glacier turned out however to be so broken up by gaping crevasses and tumbled masses of ice that our route had to be made laboriously down the left wall of the valley. This is an interesting point, for it appears that this glacier must be subject to periodic changes, sometimes being relatively uncrevassed and smooth, at other times highly broken up and almost impassable as a route. This question of periodic change may have a bearing on the use and disuse of routes over the Karakoram range.

In conclusion, I should like to thank Mr. Shipton very much for his invitation to join the expedition, and for the extremely efficient way in which it was run.

The President: We have been listening to the latest account of this new survey. I think now we ought to go back half a century in order to listen to a description by one who was a pioneer surveyor in this region. You have already heard his name mentioned this evening—Sir Francis Younghusband.

Sir Francis Younghusband: I should like at the start to thank Mr. Shipton for his very kindly and indulgent references to me. For quite fifty years I have been afraid of Shipton and Tilman. It is true that they were not born when I was there, but I knew they would be sooner or later, and that one or other of them might indulge in the sport of picking holes in what their predecessors had done. But they have been kind enough to let me off very lightly, and I thank them most sincerely for that.

You have seen the photographs of that region, and you can imagine the excitement with which I looked upon them, but I must confess that I was disappointed at the result. They were as good photographs as it was possible to obtain, but any one who has actually seen these mountains will, I am sure, admit that they do not give the faintest idea of the impression which those peaks make upon one on the spot. And here I would like to go back to a Presidential Address I gave to this Society about twelve years ago in which I urged the importance of describing natural beauty. I said then that while geology is concerned with the interior of the earth, it is by convention left to geography to deal with the surface. And I argued that describing the beauty on the face of Mother Earth was as much a matter for geographers as the mapping of it. Therefore I very much hope that now that the map of this region is fairly well completed Shipton and Tilman will return there and bring us back real pictures of it. I hope that they will devote perhaps another season to climbing the heights for no other purpose than, as Shipton has said, to see the view. Tilman
stated that this is the finest mountain scenery in the world, and I would corroborate that from what I have seen of other parts of the Himalaya.

I thank Mr. Shipton very warmly for his lecture and I congratulate him on the splendid piece of exploration he has done.

The President: We have another and more recent pioneer with us whose name has also been mentioned this evening, namely, Professor Mason. I should be very glad if he would say a few words to us.

Professor K. Mason: I should like to second Sir Francis Younghusband's vote of thanks to the lecturer, and to congratulate him and the other two who have spoken, as well as the one who is absent, on a very magnificent performance.

I am not homesick to go back, especially when I see these pictures of rope bridges and the like. I always hated them, and I also disliked the rivers. No photograph can bring out their dangers, when they are coming down in flood, with great boulders rolling with the stream, boulders which can easily break a man's leg. They do not invite one a second time. It was not the mountains, but the flood water in the Zug Shaksgam river that eventually stopped our progress.

The President: You will agree with me when I suggest that this expedition was one which was thoroughly worth while, and it is interesting to learn at what very small cost it was carried out. That is a very important factor, because it is always very difficult to raise money for expeditions. What they have done in the course of this expedition has been to fill in a blank upon a map which itself has been produced in the most exquisite manner. I daresay you noted in that enlargement of the Society's map of the Karakoram the intricate detail which was brought out with such clearness. It is a beautiful piece of draughtsmanship and its completion is much desired. This blank has now been filled up with equal detail, and it is a remarkable thing that so small a party should have been able to cover so much ground. It was not easy going, as you have seen for yourselves, but the party successfully departmentalized the work, breaking up into small sections, and in that way they covered a very considerable area indeed.

There is a great deal I would like to say in regard to this lecture, but I will only mention the fact that I have just received a letter from the Surveyor-General of India expressing his very high appreciation of the work which has been accomplished. As we have depended very largely upon the goodwill of the Survey of India, it is very gratifying to find that they have found satisfaction in this remarkable journey.

It only remains for me to offer on your behalf very cordial thanks indeed for the extremely fine piece of work which has been done, and also for the way in which it has been presented to us this evening. Before I close my remarks, I would like to offer all good wishes on the part of this Society to those who are proceeding very shortly on, possibly, a more important and epoch-making adventure still—the conquest of Mount Everest.