THE MOUNT EVEREST EXPEDITION OF 1936: *A paper read at the Afternoon and Evening Meetings of the Society on 2 November 1936, by*

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ON the last occasion on which I had the honour to address the Royal Geographical Society my task was to describe the fourth expedition to Mount Everest. That expedition reached a point within about 1000 feet of the summit, and we felt fairly sure that only the extreme and possibly unprecedented rigours of that particular season prevented a complete success. We thought, and with good reason, that Everest had shown herself at her very worst, and that it was unlikely that weather alone would stop a future expedition. We were wrong; the mountain had more shots in her locker, and in laying before my audience the results of this year's expedition I have the invidious task of describing how a party of exceptional competence met with weather not experienced by any previous expedition and was unable to reach a height greater than that attained by the reconnaissance of 1921.

The Tibetan Government's permission to try again was unexpected so soon after the attempt of 1933, but it did not find the Mount Everest Committee unprepared. Unhappily it arrived too late in the season to permit of a full-dress expedition in 1935, but there was time in that year for work which many of us considered a necessary preliminary to a really well-organized assault. That explains the reconnaissance which was led by Shipton last year, of which I will recapitulate the objects:

1. To collect data about monsoon snow conditions at high altitudes and investigate the possibility of a monsoon or post-monsoon attempt.
2. To examine the possibility of alternative routes from the west. Two had been suggested: the north-west ridge which rises from the head of the Central Rongbuk glacier; and the practically unknown Western Cwm, which is really a tributary of the valley which contains the Khumbu Glacier.
3. To report on the present ice formations on the North Col.
4. To try out new men as possible candidates for the main expedition and to secure for them preliminary acclimatization.
5. To try out new designs of tents and other equipment; and also new ideas for provisioning high-altitude expeditions.
6. To carry out a stereo-photogrammetric examination of the northern aspect and valleys of Mount Everest, and to continue the work of the Reconnaissance Expedition of 1921.

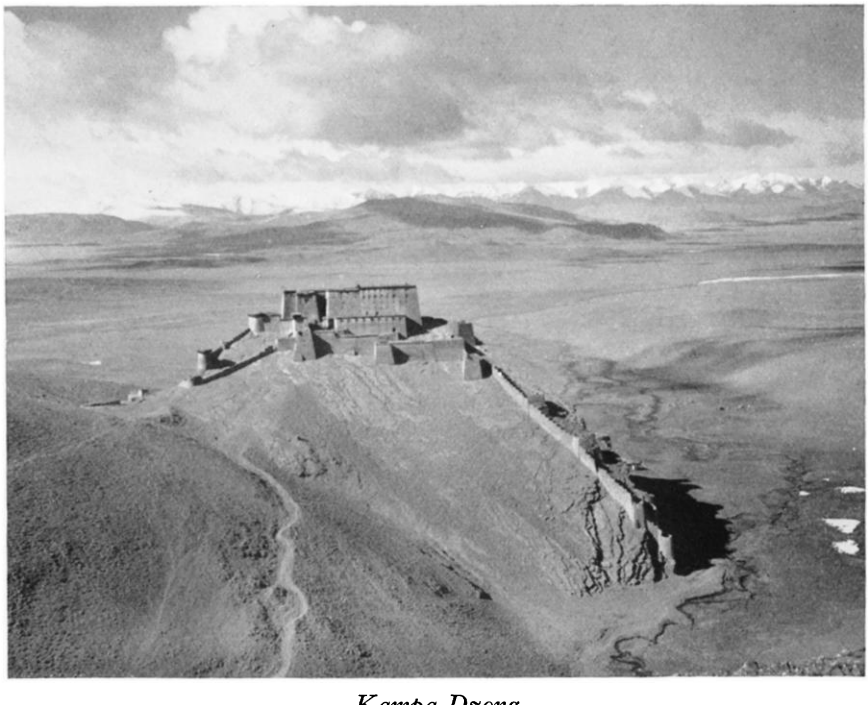
Those of you who were present here when Shipton read his paper on December 2, or who have studied that paper in last February's number of the *Geographical Journal*, are well aware with what skill that reconnaissance was conducted, and how much additional knowledge it contributed. From the point of view of climbing the mountain the principal results obtained were an enhanced knowledge of monsoon snow conditions; the trial under high altitude conditions of five new candidates, of whom three were found to acclimatize well; an improvement in equipment; and an excellent survey of the north face by Mr. Spender, with fixation of its salient features.

It was made clear to the Tibetan Government that this reconnaissance was part of the main expedition which would start in 1936, and this enabled us to double the amount of work which would otherwise have been possible. Few climbers can spare the time to visit the Himalaya in two consecutive years; yet it was desirable to test as many candidates as possible among the mountains, for experience has shown that a man's climbing record is not a complete guide to his abilities on an expedition, so Smythe spent part of the summer in the Alps trying out new men. The result was that by the end of October we had a considerable amount of practical data on which to base our selections, and a party was eventually assembled which for general ability, experience, and homogeneity could hardly be bettered. The Mount Everest Committee gave the leader very full discretion, and for his part he lost no opportunity of consulting Smythe and Shipton in the first place, and other members of the party as it came into being. The size of the party was brought down from sixteen in 1933 to twelve this year; of these, nine had been to Mount Everest before, and one (Oliver) had climbed Trisul. Of the remaining two, Humphreys, our senior medical officer, had much experience of expeditions; Gavin was the only member without experience outside Switzerland, but his performance with Smythe during the summer and the extraordinarily good report given him by the medical board of the Royal Air Force secured him a place; of which I may add that he showed himself entirely worthy.

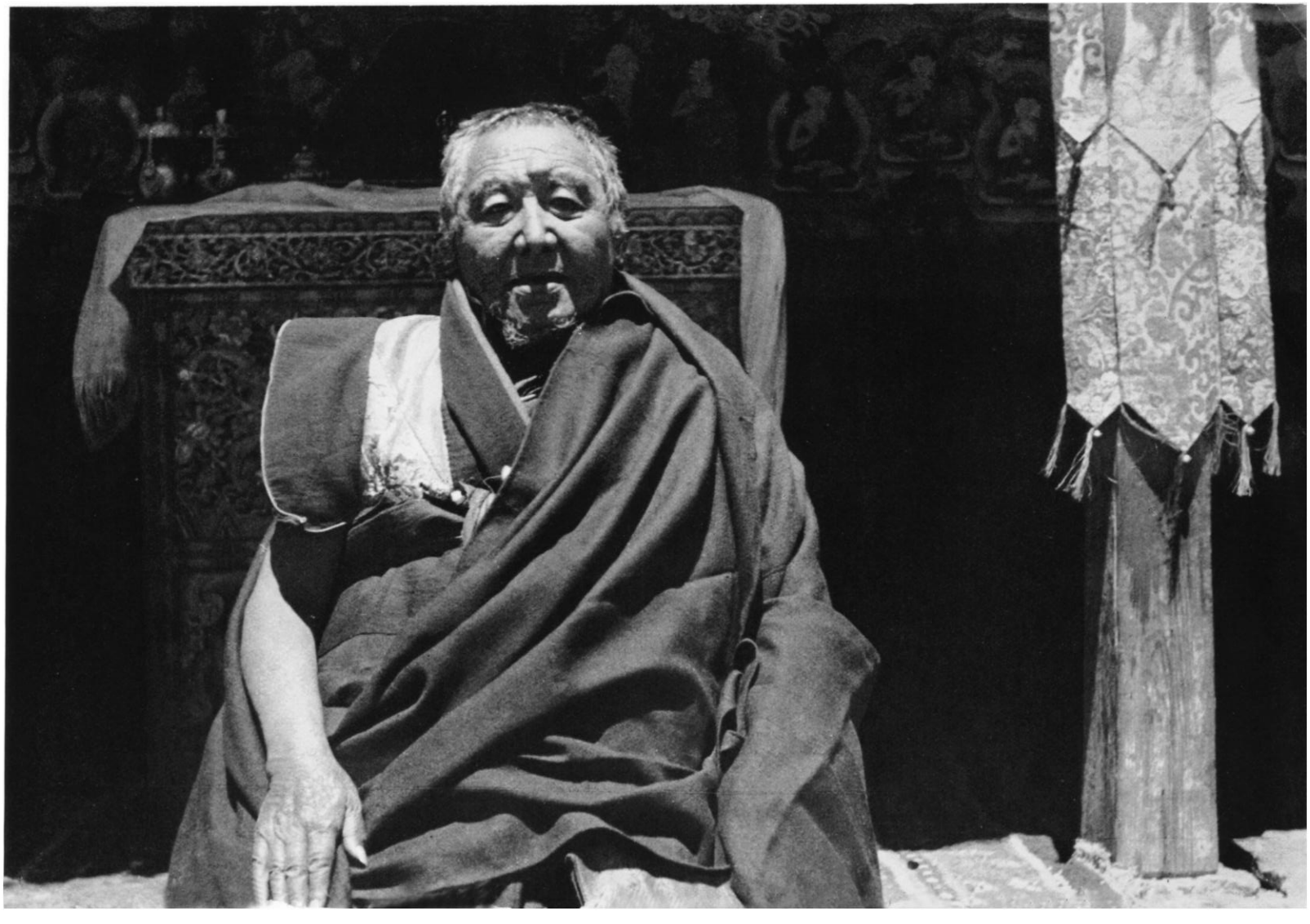
Each successive expedition is able to add something in the way of improved technical detail to its equipment and its food supply. Here I need but mention a new kind of arctic tent which was intended to mitigate the extreme rigours of life at Camp V, and the provision of pressure cookers. Special mention should however be made of oxygen apparatus; Sir Leonard Hill has continued to press with force and ability his view that little if any real acclimatization can be attained above 21,000 feet; and that, although we know that exceptional men can reach a height of 28,000 feet without artificial oxygen supply, conditions above that may bring about a sudden and most dangerous alteration in a party's climbing power. Having heard Sir Leonard Hill's opinion, we consulted the experts at the Royal Air Force establishment at Farnborough, and they most kindly cooperated in various tests conducted in the pressure chamber there. Their experience, though not entirely relevant to our case, seeing that the pilots on whom their tests are usually made are quite unacclimatized, indicated that changes in a man's condition due to failure of oxygen supply may be very sudden. The upshot was that, with the most generous and practical assistance of Sir Robert Davis, a new form of oxygen apparatus was taken out, of which Warren has made a special study. Many experiments were made with this apparatus during the expedition, but we never had the opportunity to test it at very high altitudes. So far as it went, it gave encouraging results, though some of our best men still think that the mountain can be climbed without it and that the risks of carrying so much weight on difficult ground or of a sudden breakdown of the apparatus more than counterbalance its value.

This year the expedition was brought out in echelon, as it were, to obviate waste of time and money. Morris was out first, and his perfect knowledge of Nepali and understanding of hillmen enabled him to collect the finest body

Kongra La



Kampa Dzong



The Lama of Rongbuk

of porters that could possibly be desired. Sixty-five of these men were to accompany us throughout the march; but two recruiters were also sent into Nepal to arrange for more than one hundred additional men to join us at Rongbuk on our arrival there. No praise can be too high for the conduct and ability of these men. Several of them, especially those brought direct from Nepal, were as wild as hawks, and I well remember Morris' cry of delight during an inspection in Tibet when his knowledge of ethnology convinced him that he had discovered a living Neanderthal man. They knew nothing of ice slopes or of snowcraft, but they had the natural strength, ability, and spirit of the true hillman, and with a stiffening of porters who had been to Everest before they refused to be intimidated by any conditions or any difficulties. This time we promoted old and tried hands to the position of sardar or under-sardar with the most happy results. Given responsibility, these men saw to it that the recruits were kept in order, revelling in a discipline which in their younger days they had themselves often ignored; and they were given charge of specific portions of equipment and stores, with such success that at the end of our long march to the Base Camp only two or three tins of soup were missing, and those had probably fallen out of a disintegrating box.

Allotment of work was made at a very early stage: Smythe and Wigram managed the Mess; Morris and Oliver the transport; Shipton the porters; Kempson the postal arrangements; Humphreys and Warren, besides their medical duties, dealt with physiology, the oxygen, botany, etc.; and Smijth-Windham found a most able understudy for the wireless in Gavin. Wyn Harris, undeterred by the miseries of account keeping in Tibet in 1933, resumed this thankless task. I must not forget to mention our lively and extremely capable interpreter, Karma Paul, who has been with every expedition except the first; nor Jemadar Lachhman Singh Sahi of the 1/3rd Q.A.O. Gurkha Rifles, who was with us in 1933, and Lance Naik Lilambar Rana and Lance Naik Gopal Gurung of the 2/3rd Q.A.O. Gurkha Rifles, specially selected by Morris for work with the transport and arrangements of camps. Jemadar Lachhman Singh gave Wyn Harris invaluable help in bookkeeping, and the other two were always willing to do whatever was asked of them. All stores were assembled at Kalimpong, where we received that practical help and most kind hospitality which make us consider Mr. and Mrs. Odling as valuable members of Mount Everest Expeditions. The real march was begun on March 19 from Gangtok, where we experienced similar hospitality and goodwill from His Highness the Maharaja of Sikkim and from Mr. B. J. Gould, Political Officer in Sikkim.

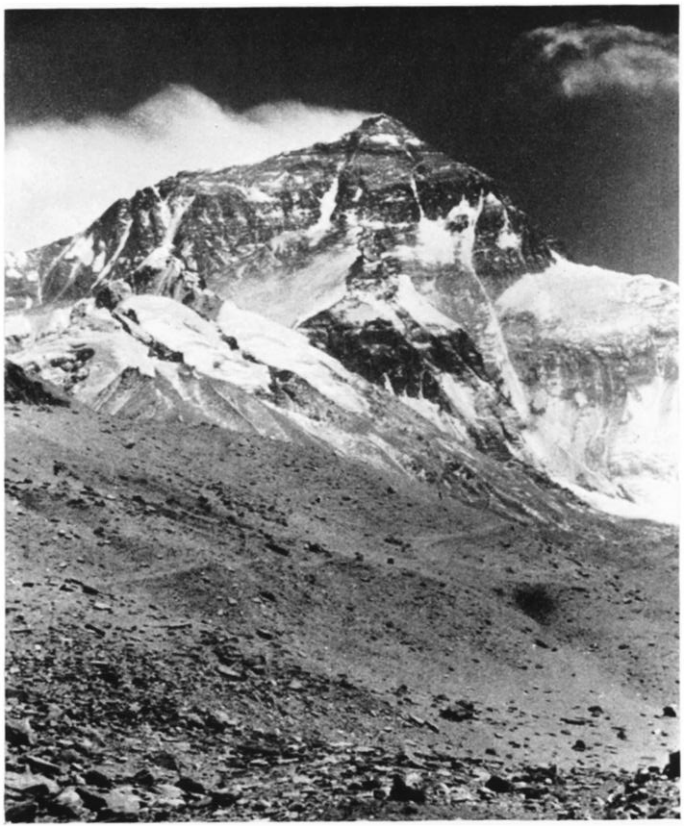
Before leaving, a complete and detailed plan of assault had been worked out at a staff meeting attended by Smythe, Shipton, Wyn Harris, and Kempson. These staff meetings were a great help; they enabled the leader to collate the views of the most experienced men and, while not forgetting his own responsibility to make definite decisions, to obtain the greatest measure of general consent. Mountaineering parties do not, or should not, require the methods of dictatorship. It had been decided, after considerable inquiry, to risk crossing the two high passes in the north of Sikkim direct to Kampa Dzong in Tibet. We knew that these two passes, the Sebu La and Kongra La, were not in any way difficult or dangerous. The Maharaja of Sikkim saw to it that

tracks and bridges were repaired, and that adequate transport was forthcoming; the rest was easy. So we left the beautiful green valley of the Teesta river for the narrow gorges, the stony mule tracks of upper Sikkim, and ultimately the rolling downs of the Tibetan plateau.

A deliberate halt of some days was made at Thangu, the last rest-house in Sikkim. Here, at a height of about 13,000 feet, it was thought that we might acquire some preliminary acclimatization and find our mountain legs. A height limit of 18,000 feet was imposed, lest enthusiasm should outrun discretion and bring on staleness. Incidentally, this halt gave Morris the opportunity to recover at least partially from a severe attack of malaria which had overwhelmed him at Lachen and very nearly brought about his summary return to India. The passes were crossed on April 2 with a refreshing absence of distress, a contrast to the misery experienced there last year. By this route we had saved ourselves from the appalling spring conditions on the Phari plain and saved at least five marches. Marching across the plateau this time was almost unalloyed pleasure; the weather was comparatively warm, and our welcome was not even comparatively so, for we found old friends among the Tibetan officials who seemed positively pleased to see us again.

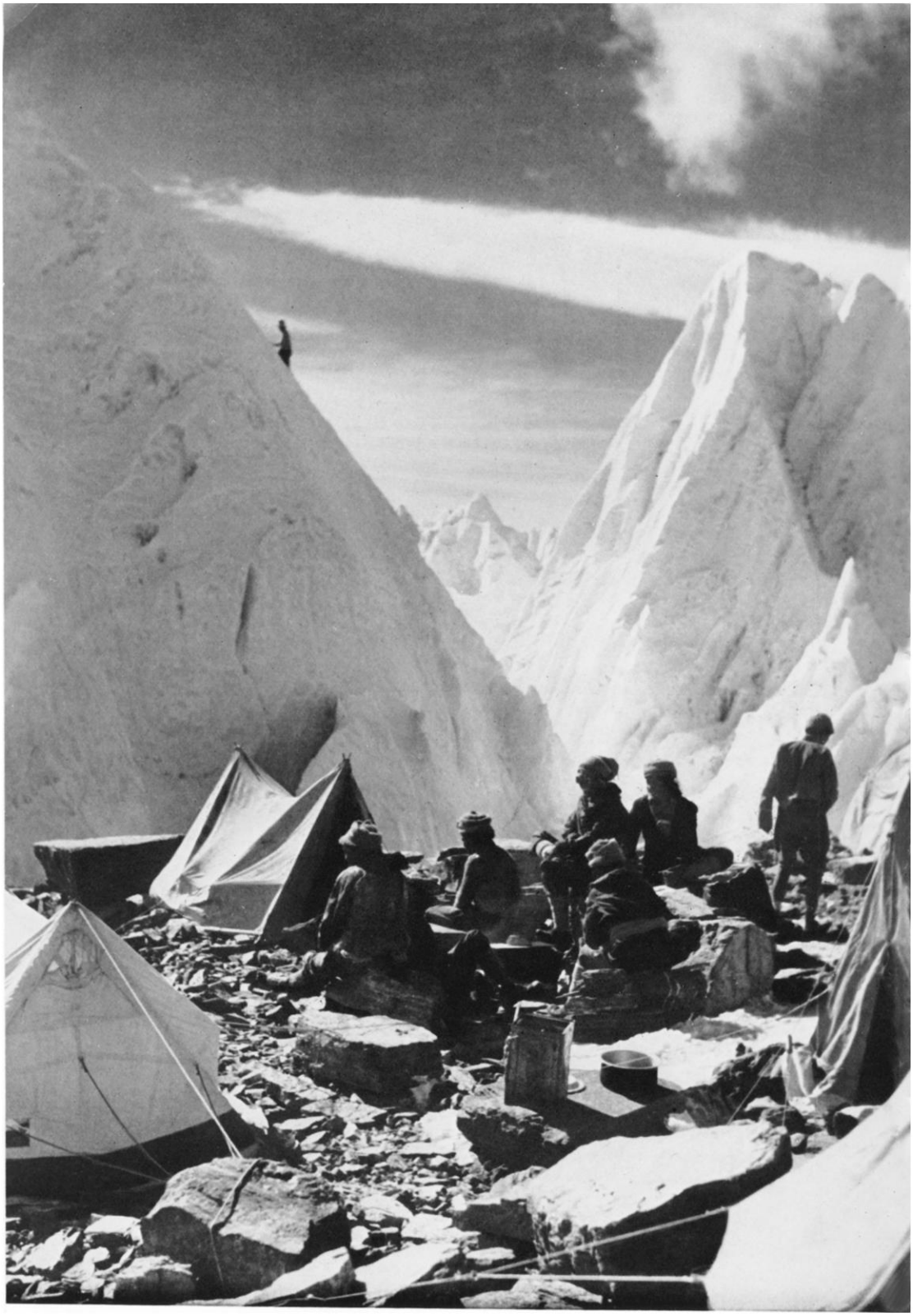
At Kampa Dzong there was a display of horsemanship and shooting; the riders were arrayed in medieval costume, and their object was to gallop past a small target fixed on a stick and to hit it either with gun shot or with a stone. The latter appeared to be the more dangerous weapon of the two; indeed, I have never seen the equal of Tibetans at stone throwing. At Tenkye Dzong the people probably remembered our Olympic games of 1933. They turned up in considerable force to watch and participate in when possible our games of football with the men. At Shekar Dzong we were most cordially greeted by the same Dzongpen as before. He even lunched with us, finding about as much difficulty with our knives and forks as we had had with his chop-sticks, and commenting favourably upon the cleanliness of our service. Fortunately he did not inspect Chun-Chun's arrangements for washing dishes round the corner.

Although we were experiencing splendid weather on this march, we had on several occasions observed disturbed conditions over the Everest region, and I do not think that an earlier arrival at the base camp would have been profitable. However on April 26, when we reached Rongbuk, the mountain looked absolutely magnificent, and in the best condition for climbing except that a strongish wind, estimated at between 40 and 50 m.p.h., was blowing a great plume of snow and ice away to the south-east. The old Lama of Rongbuk, though he shows unmistakable signs of advancing age, gave us a splendid reception. This time we felt that he was really pleased to see us; he gave us tea, blessed both us and the porters, told us to be very careful, and was convinced that we were going to have fine weather. This latter opinion, I may add here, had been offered in a more cautious way by the meteorologist at Alipore when I visited him in February. He then said that there were no indications that we were to have an abnormally early monsoon; western disturbances from the Persian side might give very bad weather in the Everest region at intervals, but for short periods only; the monsoon, when it did come, should take between a fortnight and three weeks to pass up from Ceylon to Mount



Mount Everest in good condition

Mount Everest in bad condition



Camp II

Everest; on the other hand, what he called the equatorial current in the Bay of Bengal seemed to be rather strong and might increase the rain-bearing capacity of western disturbances, but it should split up in the neighbourhood of Orissa, one part going towards the United Provinces on the west and the other towards Assam on the east. On the whole it seemed likely that we should get better weather than in 1933, and there was quite a chance that there would be an interval of comparative quiet between the first arrival of the monsoon and its full establishment.

All this was very encouraging, and no time was lost in getting to work to establish the camps on the East Rongbuk glacier. Everybody was well; there were none of the sore throats which had been so troublesome on the last occasion. The old Base Camp was complete by April 27. We had decided to make Camp I our real base this year, but to retain the old names of camps, to avoid confusion. Smijth-Windham decided to have his wireless base at Camp I also, so for the next four days very heavy work was demanded of the entire porter corps, several of whom made double journeys with extra heavy loads. But not a man broke down or grumbled.

Smijth-Windham got into wireless communication with Darjeeling from Camp I on April 30, and was immediately informed that a disturbance might be expected. The same evening snow fell. This did not worry us, as disturbances are always to be expected at this time of year. Little did we think, as the mountain turned from black to white, that never again should we see her as she must be if success is to be attained. It was observed at the time that the snowfall was not accompanied by a heavy north-west wind and we carried on with the work, experiencing very little discomfort. Camp II was made at a place observed by last year's reconnaissance, in the central trough of the glacier, a far better place than that used before, and on the direct line to Camp III. I remember that on our first night there the approach of high-altitude conditions was shown by our failure to see much humour in the short-comings of our cooks. But this was a minor matter, and on May 7 and 8, that is to say within twelve days of our arrival at the Base Camp, Camp III was in full occupation as our advance base.

Our original plan, worked out in detail at Gangtok, had been to make Camp IV on the North Col on May 22 and to commence the assault up the north ridge on the 25th. The condition of the party however was so good that it was decided to try and have Camp IV completely organized by May 15, and to commence the assault on the 18th. The first part of this plan was successfully carried out; Smythe, Shipton, and Warren made a preliminary reconnaissance of the North Col slopes on the 9th. They found that the ice formations had changed considerably since 1933 and that it was no longer possible to attempt the direct route of that year, principally because the ice-wall appeared to have doubled in height. Accordingly they began work away to the right and cut steps up the first 500 feet direct. From that point it would be necessary to make a long traverse—a thing no one likes doing on slopes of this character—and then force a way direct up to the crest. On May 13 Smythe, Oliver, Wigram, and Gavin with ten first-rate porters made the whole route up to the crest, fixing ropes over a great portion of the route. This was a desperately hard day's work, but it was so well done that next day

Wyn Harris and Kempson had no difficulty in escorting forty-six porters, half of whom had never been on an ice slope beforh, and established Camp IV on the crest. The old ledge of 1933, some 240 feet down, had now disappeared.

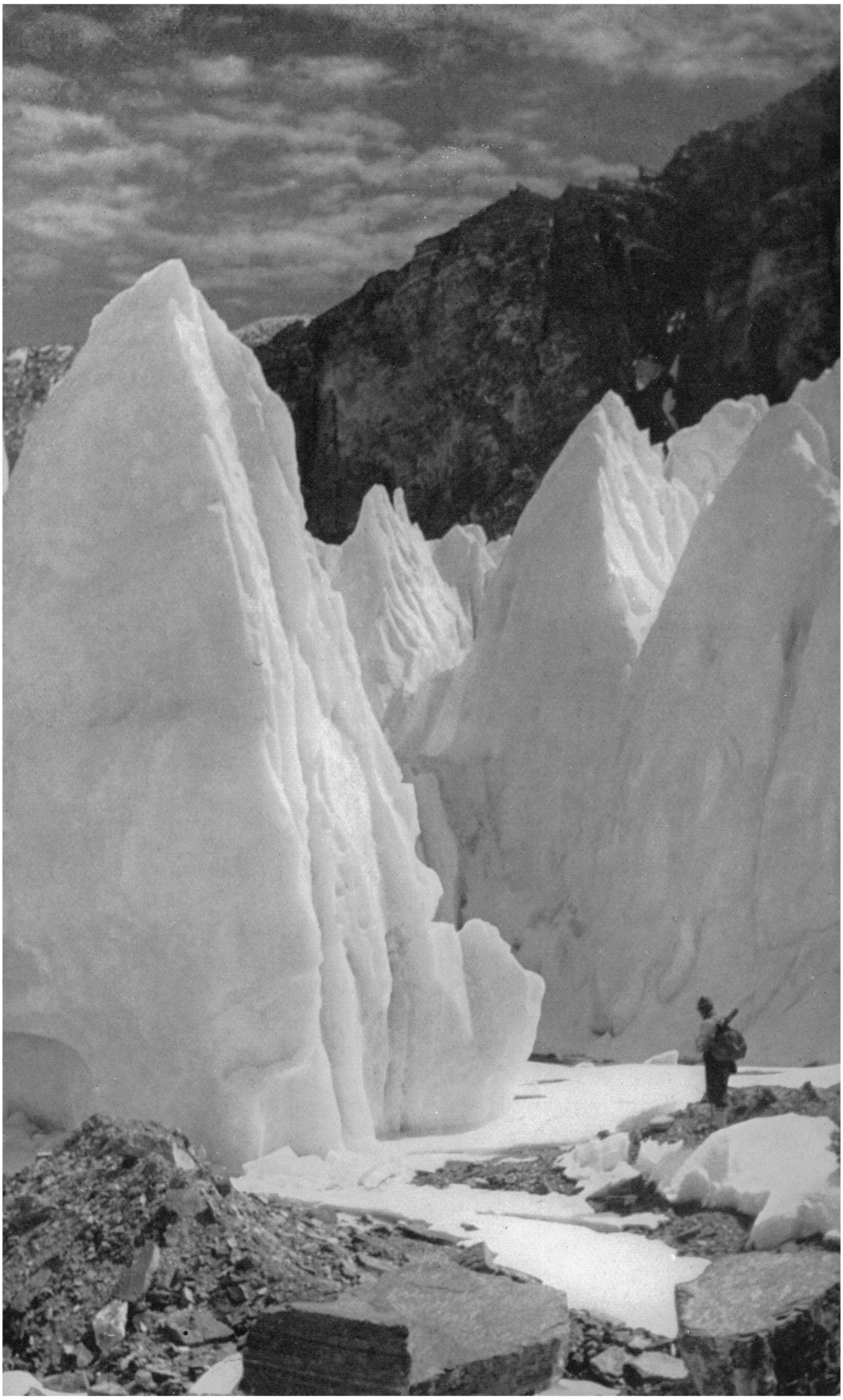
They returned to Camp III, which by the way was placed this year 500 feet higher and much nearer the foot of the North Col than before, the same evening. Next morning, May 15, Smythe and Shipton occupied the North Col with fifty-six men, of whom forty-two remained to establish the higher camps. It should be observed that all this had been done without anything like the exposure, danger, and distress which the work entailed in 1933. There was practically no wind and everybody was in splendid form. That was the end of our good fortune. There was not a great deal of snow on the mountain at this time, but what there was showed no tendency to disappear and was being steadily added to evening by evening. We positively longed for the north-west wind which alone could remove the snow. Day after day was unhealthily warm, with slight breezes from the east. Smijth-Windham's high-altitude light wireless sets were working splendidly, so that I was in constant touch with Smythe. The wireless telephone exchange at Camp III had been set up and was being worked with great skill by Gavin.

Morning and evening Smythe said that conditions were getting worse and that he did not advise any attempt to establish Camp V yet; and on the 18th he gave his opinion, supported by Shipton, that it would be useless to hold the camp any longer for the present. There were about 2 feet of snow on the North Col itself, and any amount higher up; and some of the porters were showing signs of strain. In any case we knew that a prolonged stay on the North Col would be of benefit to nobody. Smythe brought his party down the same evening; watching them from below, we could see that every mountaineering precaution was being taken lest an avalanche should occur, especially on the dangerous slopes of the traverse. It was a great relief to have the whole party down safe.

The climbers had now been at or above Camp III for eleven days, and it was obvious that the mountain would not be climbable for some time, even should the north-west wind get up. It was accordingly decided to exchange the comparative discomfort as well as the altitude of Camp III for the milder conditions of Camp I. I had already begun to notice that when a party cannot be kept fully occupied at these altitudes the strain of merely living there seems to take more out of them than if they have definite and continuous work to do. An immediate improvement in health was at once observed at Camp I. During our stay higher up Morris had had to be brought down from Camp II, where he was desperately ill with a renewal of his malaria; and Humphreys at this time was a good deal worried by a sore throat. However, Camp I was a very cheery place indeed until next morning, May 20, when Alipore reported by wireless that conditions favourable for the formation of the monsoon in the south of the Bay of Bengal had been observed.

Up to this moment we had not had the slightest reason to suppose that the monsoon would be even heard of before the end of the month; so this news was a most disagreeable shock. The staff met at once, and although we had only come down from Camp III the day before, we decided that we must

The trough of the East Rongbuk Glacier



return immediately and place ourselves in position to make at least one attack before the monsoon arrived, even if this meant tackling the North Col and the slopes beyond while there was more snow on them than we liked. It was just possible that what is called the Chhoti Barsat, or first portion of the monsoon, might exhaust itself upon the Darjeeling foothills and never reach us, and that there might then be a quiet interval during which we could continue the assaults without interruption. The party was ready for anything, and by the 24th we were again in full occupation of Camp III. The prospect there was anything but reassuring; indeed, dismal prospect speedily immerged into grim certainty. Incredible as it may seem, the monsoon rushed up from Ceylon to the Everest region in four days instead of the usual fortnight or three weeks, and hit us hard on the evening of the 24th. I am assured on good authority that this phenomenon has never been observed before. The only explanation can be the total failure of the normal north-west wind to stem the current.

Camp III was anything but a pleasant place of residence during these days; and the North Col was obviously unapproachable. I find from my diary that, for lack of anything better to do, I made the tentative suggestion that we might go round and have a look at the west side, which Mallory had rejected in 1921. Those members of last year's reconnaissance who had seen it did not think that anything could be done there, so the proposal was dropped for the moment; and on receipt of a definite warning from Alipore that a severe storm was on the way a second retirement to Camp I was ordered, and accomplished on the 28th through a quite sufficiently unpleasant blizzard. But the mountain had not yet finished amusing herself at our expense; next morning we awoke to find for the first time a really strong north-west wind blowing. This was the most welcome of all possible changes, and we lost no time in going down on to the Main Rongbuk glacier, from which the mountain could be seen. Snow was being blown in enormous sheets off the great north face in a way which promised a complete clearance in two or three days. We hurried back to lunch and were met by a delighted Smijth-Windham, who produced a wireless message to the effect that the monsoon showed signs of weakening and had been driven off towards Assam. Whatever the wind, we could not neglect this opportunity, and the party rose as one man for the third ascent to Camp III.

But it was not to be so easy as that. At the very moment of our starting the north-west wind appeared to hesitate, and by the time we had reached Camp II very heavy snow was falling, and Mount Everest was completely weatherbound until the morning of June 3, when we had to make the best of the fact that the north-west wind resumed its activities simultaneously with the arrival of a weather report that we might now expect the monsoon from the Arabian Sea as well as from the Bay of Bengal. Camp III was just a wilderness of snow, and the North Col looked like a stage set for the Ride of the Valkyrie, with snow instead of smoke flying up in great columns into the sky. However at least this snow was being blown about and not just lying idle with a view to avalanching, and on the morning of the 4th, Smythe, Shipton, and Kempson made a cautious examination of the lower slopes, finding them very much better than they expected, although of course all the steps and ropes had long

Camp III and the North Col

ago been covered up. After a thorough discussion at a staff meeting it was decided that, if the very greatest precautions were taken, it was justifiable to try again to occupy Camp IV with an assaulting party.

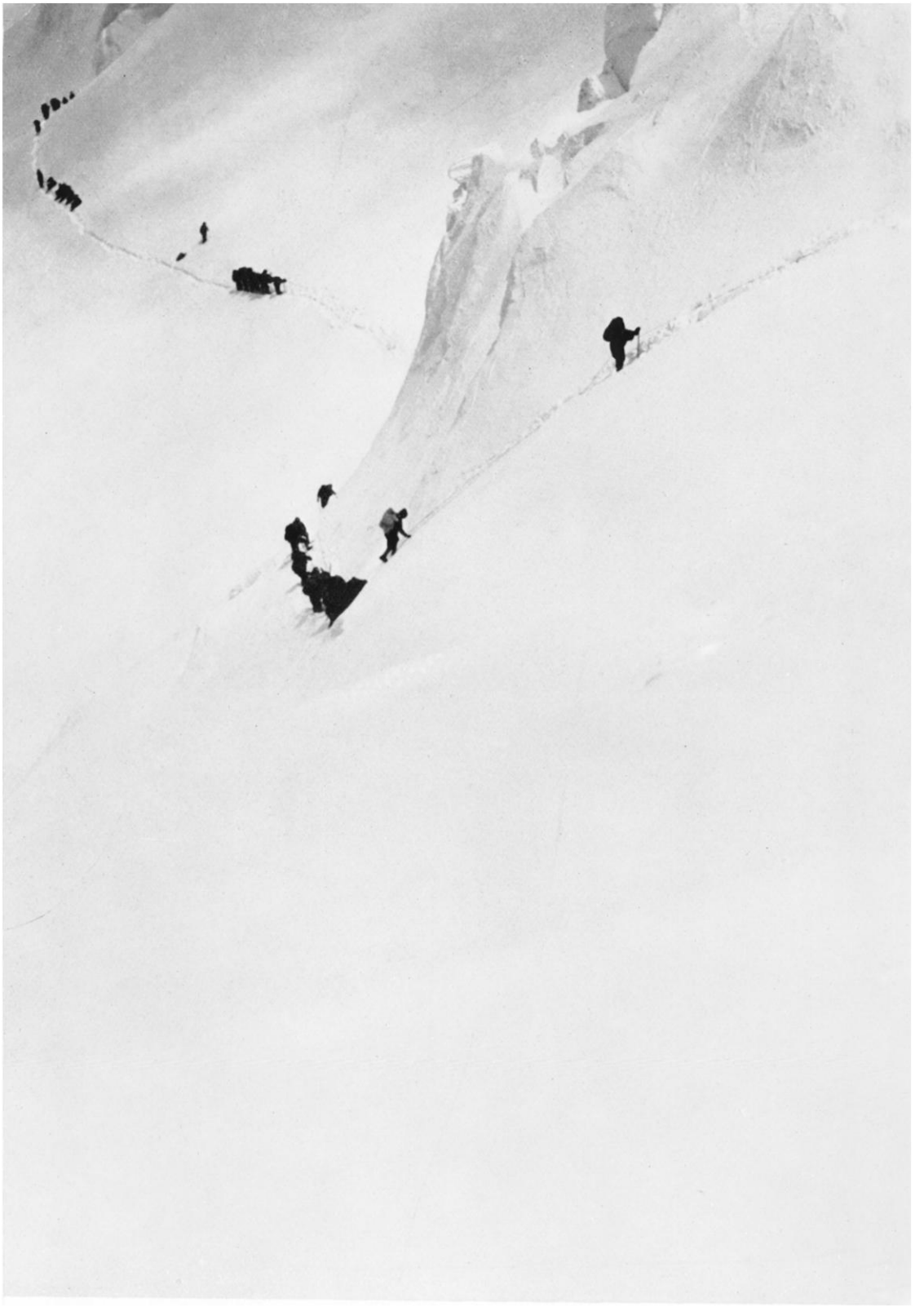
This last effort was most carefully planned in view of the obvious danger from avalanches. The whole climbing strength of the party was to be used, the men working in pairs in turn. Smythe, my second in command, was placed in charge of the operations, and would accompany each pair of climbers, deciding at each stage of progress how much further it would be possible to go. The porters were divided up into small parties under control of Shipton. These parties were to move in succession as the route was made. There was to be no hesitation about a retreat if the conditions were too bad. A very cold night was a promising beginning. Wyn Harris and Kempson were off very early to tackle the first 500 feet. They were not reassured by finding the debris of a small avalanche across their route, but after a careful discussion with Smythe, who had now joined them, it was decided to complete this section. Smythe then went on with Warren and Wigram and they reached a crevasse which marked the beginning of the traverse, the state of which would of course decide for or against the venture. Meanwhile Oliver and Gavin halted the leading party of porters a little lower down and Shipton was still further below with the remainder.

At once it became evident that the snow on the traverse would never hold. Smythe who, as he has told me since, felt that if we did not reach the North Col on this day we should never get there again, made up his mind there and then to try a very difficult line of ascent straight up to the crest. A frontal assault of this nature would certainly be safer than a traverse, and all Smythe's fighting instincts had been roused by our recent disappointments. But this frontal attack was too much for even mountaineers of this calibre; immediately ahead soared two frightfully steep walls of ice, between and beyond which was almost equally steep snow of the very worst description; altogether at least 400 feet of extremely difficult going. I very much doubt if this could have been climbed at the much lower altitude of the Alps; certainly it would have been impossible to bring the porters up. After a very little step-cutting Smythe realized that the game was up and quite rightly gave the order to retreat. Shipton, in frightful anxiety for his beloved porters, had already started them downwards. The retreat was conducted with very great skill, and I for my part shall never forget watching it.

All that evening and next day we were stormbound—this was our one really violent gale of the year. As the tents shook and trembled under the gusts, physical activity had to give place to argument, of the full-flavoured kind which perhaps only high altitude conditions can produce. I missed the cream of it as I was busy writing in my tent. Besides, I should have to make an eventual decision and was better away from the heat of battle. Next morning, when all the snow of this region seemed to be in the air at once instead of on the slopes, Wyn Harris came into my tent with an air of purpose and begged that in the event of the wind falling a little he and Shipton should be allowed to go and have one final look at the slopes, just to see if they had been swept clear. I agreed to this; both men were supremely competent mountaineers and knew exactly what they were up against. They were clearly

Camp IV

The North Peak from Camp IV



Traversing the North Col

determined that the quality of those slopes in these conditions and at this time of year should be ascertained for good and all.

After lunch there was a slight lull and they set off. Smythe and I watched their progress through a little opening in my tent, closing this up at intervals when the gusts were desperately bad, and finally going over to Gavin's arctic tent when the wind became intolerable. Progress was unexpectedly rapid up the first 500 feet, and we began to hope that things were not too bad after all. Then they came to the crevasse and halted to rope up before examining the traverse. Shipton led out across what seemed to be good, hard, compacted snow, well attached to the ice beneath; it held his boot nails well and was not very steep. Wyn Harris had just begun to move in his turn when a sharp crack sounded some 200 feet up. There was a moment's dead silence and then the slope began to move, breaking up as it did so into the blocks of ice characteristic of windslab avalanche. Only a few yards down the slope ended in the brink of a 400-foot ice precipice. Shipton was instantly thrown on to his back and carried down among the ice blocks. Wyn Harris, making a desperate effort, leapt back towards the lower lip of the crevasse and drove his axe deep into the hard snow; as he did so his left hand, which held the coils of rope, was crushed against the axe head and he had to let go momentarily to let the rope run out to its full length. He remembers being thrown on to his back, recovering his feet in a flash, and again jamming the axe into the snow with the rope round it; he was just free of the avalanche. As the rope tightened, Shipton, who had begun to slide from a point roughly on the same level as Wyn Harris, was gradually pulled in the arc of a circle towards the edge of the avalanche, but of course below Wyn Harris. Just when it seemed that the straining rope must pull the axe out of the snow and Wyn Harris with it, the avalanche slowed down and stopped close to the brink of the ice precipice. It is of course impossible that Wyn Harris could by his action have arrested the fall of many hundred tons of ice, but it may be that there was a slight easing off of the slope just before the drop and that Wyn Harris by taking his own weight and that of Shipton and the surrounding ice blocks off the avalanche contributed to its halt. Certainly he did the right thing at the right moment. Shipton was completely winded, and both men were naturally a good deal shaken, but they pulled themselves together and descended to safety without further incident.

There was of course no further argument; the North Col had had the last word. Camp III was completely evacuated and Camp I reached next day. I think we all knew that the mountain was finished with for the year. Transport had already been ordered up from Shekar Dzong, and it was thought that we might employ the interval before its arrival by going up the Main Rongbuk glacier and examining the west side of the North Col, more as a piece of interesting exploration than as a serious attempt to reach the Col by this route. The very next day, June 8, the entire party set off. I wanted Smijth-Windham, who had had a very busy time at Camp I, sending off no less than five hundred wireless messages, to take a holiday. He entirely agreed, provided he could take with him one of his light wireless sets for further experiment. Our first camp at about 18,000 feet was a joy to look upon—green grass at 18,000 feet and in the middle of it a lark's nest with two eggs in it. We

pushed on next day to what was called North Face Camp, near the south-west shoulder of the North Peak, at about 19,000 feet, and next morning went out on to the open glacier towards the Lho La to obtain a view of the Col. That view came suddenly and most dramatically. The slopes to the Col rise out of a little glacier bay, and are not properly visible until you are well out on the glacier. Instead of the very long and steep approach which we had expected, we saw an icefall which could certainly be negotiated, leading up to a not difficult *bergschrund*, and above that perhaps 800 feet of pretty steep snow or ice flanked to the right by ribs of rock not patently unclimbable. This was worth tackling at once, and the climbers made off across the glacier without delay. Unfortunately clouds came down very soon after, and the tired men who returned to the North Face Camp that evening were only able to report that they had forced the icefall without difficulty and gone very close to the *bergschrund*, but had been unable to see anything beyond that.

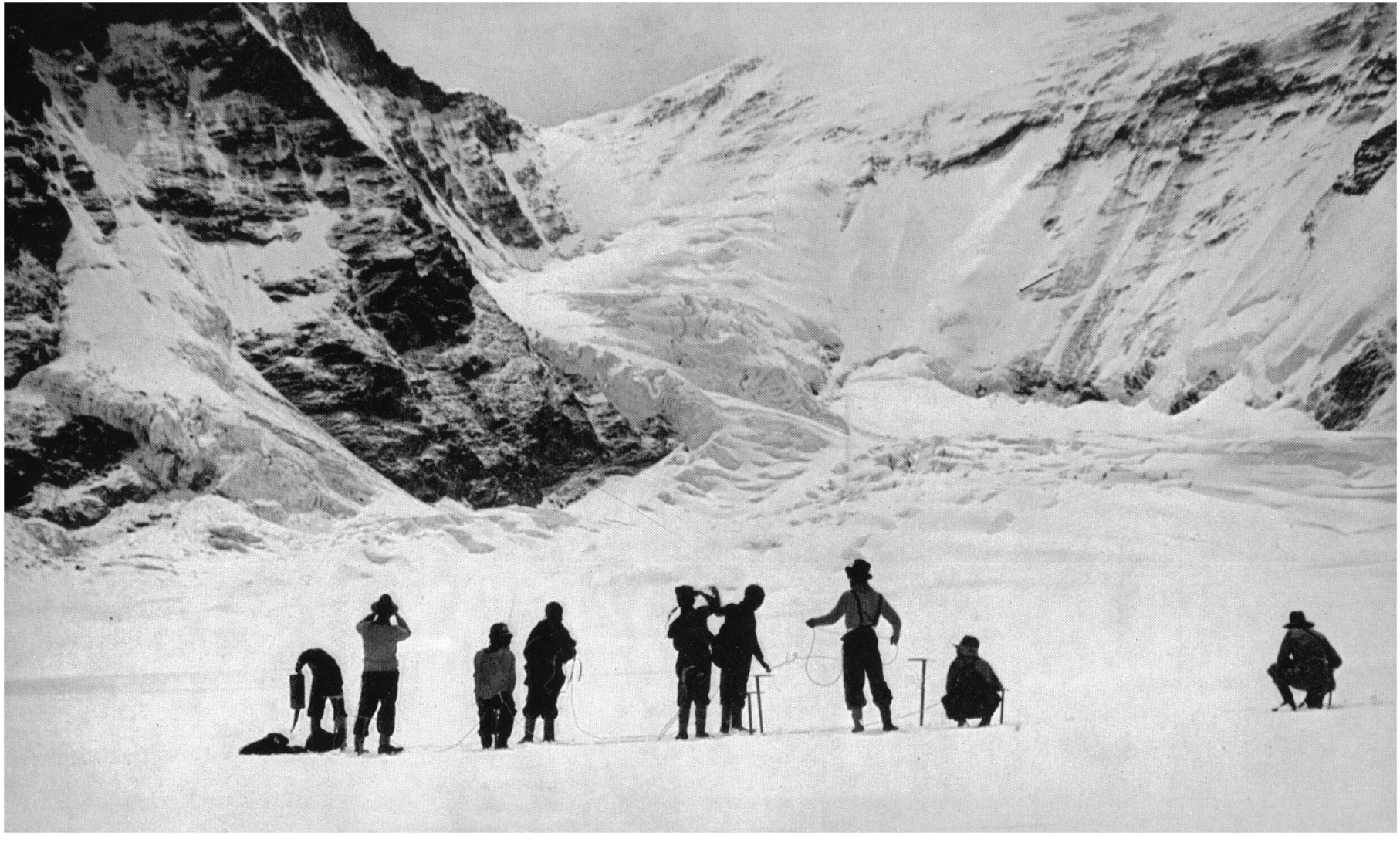
The mornings at this time were invariably fine, but snow fell very heavily each evening and the mountain was deep under it. Further examination of the slopes did not call for the full strength of the party, and Shipton had always been anxious to renew his attack on the North Peak which had been defeated last year. Accordingly it was arranged that Smythe and Wyn Harris should take a light camp up through the ice fall and close to the *bergschrund* and examine the slopes from there, Smijth-Windham and I remaining at the North Face Camp while Shipton and the other climbers should return up the East Rongbuk glacier and attempt the North Peak, from which an exceptionally good view of the north face of Everest might be obtained.

The now violent monsoon deprived both parties of success; Smythe and Wyn Harris spent a night near the *bergschrund*, just out of reach of the incessant avalanches from the North Peak, and next morning were able to form a clear impression of the possibility of ascent, though at the time they could make no further progress. They are of opinion however that this route is perfectly practicable in good conditions; that it is definitely safer from avalanche, especially windslab avalanche, than the east side; and that there appears to be no particular risk of rock-falls. Further a lodgment could probably be effected on the rock ribs to the right. If this route were made and properly roped by a good party in the early stages of another expedition it might be used as a preferable alternative to the other; at any rate it should provide a safe means of descent to a party cut off by the monsoon on the mountain. Shipton's party meanwhile had bad luck similar to that of last year, and were stopped by deep and impossible snow at about 23,300 feet.

This was really the end; we reassembled at the Base Camp and left for home on June 17. I wish it could have been possible to complete some of the survey work so well begun during last year's reconnaissance; but I had been specially requested by the Tibetan authorities to keep to the routes laid down in our passport, and the repeated thanks we received on our return march for having done so indicated how much this meant to them. I honestly think that our willingness to conform to their wishes has left a good impression, and that as far as they are concerned there is quite a good chance of our being permitted to go to Mount Everest again at no distant date.

A full technical discussion on such information as this sorely tried expedition

The final slope of the crest of the North Col



has been able to gather for the common stock would be out of place here, but several members of the Expedition have written appendices on their special subjects, of which they will give a brief account if the President calls upon them. It may suffice for me to say that we have now the nucleus of an absolutely first-rate party; that we have explored *au fond* the iniquities of the east side of the North Col; that we have made a sufficient examination of the west side to feel justified in recommending it as an alternative route; that we know a little more about the use of oxygen; that further physiological data have been obtained; and lastly that our examination of the final pyramid, though not alas by actual contact yet by telescope and binoculars, has made us fairly certain that this can be reached by Norton's route and that a choice of three possible ways to the summit presents itself. For my part, I must now cease from active participation in this great venture; but I can never forget the way in which my comrades took the rough with the smooth and made even failure a happy memory. Some day I hope they will return, and that fortune will favour them with fairer conditions; then I am sure they will reach the summit.

APPENDIX I: SELECTION AND TRAINING OF PORTERS

C. J. MORRIS

This year it was decided that the bulk of the porters should be enlisted in Sola Khombu, and that they should join the expedition direct from that place at the Base Camp. There was no doubt that as many suitable men as were required would be forthcoming; but in order to guard against this arrangement not proving entirely satisfactory some sixty porters were enlisted in Darjeeling, to form the nucleus of the corps. I think some such arrangement will always be necessary since an exceptional fall of snow on the Nangpa La might hold up a Sola Khombu party's arrival at the Base Camp for as much as two weeks, thus causing considerable disorganization to the climbing plans. The problem cannot be solved by ordering the party to arrive at a date earlier than it would normally be required, owing to the difficulty of feeding it, unless some special arrangement were made to overcome this. It should moreover be noted that if the porters are enlisted direct from Sola Khombu no sort of selection is possible; and while the great majority will be, as was the case this year, men in every way suited to the needs of the expedition, quite a number have perforce to be enlisted who would certainly not have been selected had they presented themselves for enlistment in Darjeeling. It is also desirable that as many of the porters as possible should get used to wearing their boots before serious work on the mountain commences. This is only possible when porters are enlisted in Darjeeling; but in any case most of the sardars and a certain number of other men will always be required to supervise the transport during the march across Tibet. In this connection it may be noted that a convention has somehow arisen that Mount Everest porters should carry no loads during the march. This appears to be unnecessary; and while it is obviously not in the best interests of the expedition that these men should carry heavy loads across Tibet, it is in the interests of their training that they should at all times carry something or other.

The system of organizing the porters into sections, each under the command of an under-sardar, was most satisfactory and was appreciated by the men themselves, amongst whom there was always keen competition to gain the coveted

The North Col from the west

stripe. Some members criticized this system as being too military; but any one who has had to deal with 150 or so entirely untrained and undisciplined men will quickly realize that some such method is necessary, even if only for the purpose of moving the porter corps from one place to another.

A head sardar, whose chief duty is to see to the porters' feeding arrangements and to ensure that every man does his fair share of work, will always be necessary, but the question of a transport officer, with no other duties, now seems open to question. Many of the younger members now consider a transport officer to be not a luxury but an actual encumbrance; but it should be remembered that a great deal of work goes on behind the scenes, of which they, quite rightly, have no knowledge since it is the transport officer's duty to relieve them of unnecessary trouble; and because everything seems to run smoothly there is a tendency to minimize the importance of the transport officer's duties. The route and methods of conducting expeditions across Tibet to the Base Camp are now well known, and many of the climbers of this year's expedition (and the same will probably apply in the future) have themselves had practical experience of the problem. From most points of view many of these are perfectly well able to supervise the transport and the porters. There are however occasions when it is vitally necessary that some member of the expedition should be able to speak to the men in their own language: this is a very different thing from the smattering of Hindustani which most keen members sooner or later acquire. Moreover the effect is never the same when conversation has to take place through the medium of an interpreter. The men themselves feel very strongly on this point, and will work much better when they know that if necessary they can make a direct appeal to some member of the party. If some climber can be found who knows Nepali or Tibetan really well, then I think there is no need to have a special transport officer. Until such time however even in a small party the appointment of a transport officer does seem to be most necessary, and the retention of such an appointment is in the best interests of the expedition as a whole.

APPENDIX II: TRANSPORT

C. J. MORRIS

As soon as the route was settled arrangements were made to forward the whole of our stores from Kalimpong to Kampa Dzong in batches of roughly one hundred mule loads at a time, thus enabling the climbing party to march through Sikkim unencumbered by the large quantity of transport which would otherwise have been the case.

The roads through Sikkim are for the most part extremely narrow, and unless transport is despatched along them in echelon, as was done this year, there is always liable to be much congestion and even partial disorganization, especially when, as is often the case at the time Mount Everest expeditions normally set out, there is a lot of down traffic. The methods adopted this year for despatching the transport proved entirely satisfactory and should be adopted by future parties.

As soon as we reached Kampa Dzong the whole of the stores were sorted out and checked in detail, all members of the expedition helping in this necessary but extremely laborious work. A certain number of boxes were opened and their contents checked against the detailed list in the stores book. In every case these were found to agree; and since over one hundred boxes were checked in this way it was reasonable to suppose that we were at least starting off from Kampa Dzong with everything intact.

Apart from the actual provision of transport animals, the officer in charge of transport is chiefly concerned to prevent loss and theft on the march across Tibet. In the past losses have occurred in this way, and the matter has always caused considerable anxiety lest some particular box containing, say, important items of high-altitude equipment, go astray. In order to minimize loss it was decided to delegate responsibility to the porter under-sardars. Each under-sardar was given a number of men to serve under him; and before leaving Kampa Dzong each under-sardar was allotted a definite number of store boxes. These boxes were handed over, the nature of their contents explained to the under-sardar; and he was permitted to put his own marks upon them in order to aid recognition. This having been done, each man was told that he was personally responsible for his boxes until such time as we reached the Base Camp. During each day's march both he and the men serving under him were to accompany the boxes, and at least some members of each section were never to let them out of their sight. If, as is often the case in Tibet, any particular party of animals was unable to reach camp by nightfall, then the men in charge were also to camp with the transport, sending a man on to the camp to say what had happened. Whenever circumstances permitted under-sardars were ordered to check their boxes daily, and to report the non-arrival of any particular package. During the first few days it appeared likely that we had lost at least a quarter of our entire stores; but a check by various members of the expedition disclosed the fact that this was not really the case, and the supposed losses were due to the sardars' inability to read numbers, or even to count correctly. This difficulty will always arise until the Sherpa takes to education; but provided a certain amount of help is given them, and advantage taken of halt days to carry out a general check, the methods adopted this year should prove entirely satisfactory. As it was, our total losses on arrival at the Base Camp were found to be nothing more than a few tins of soup; and it seemed likely that these fell out on the way.

In order to facilitate the work on the actual mountain it is essential that all those concerned should know exactly what any particular box or package contains. For this reason it is important that as few people as possible should have access to the boxes during the march; and that anything issued or removed from a box should be entered *at the time* in the store book concerned. It seems almost unnecessary to mention a simple routine matter such as this; but in actual practice it is so often neglected, and liable to cause such endless confusion and delay on the mountain, that I feel it essential to place it on record. For the same reason keys should be given only to those members who are actually required to deal with boxes; otherwise indiscriminate opening of boxes takes place, no record is kept of stores expended, and by the time the expedition reaches its base the store book is completely valueless.

APPENDIX III: WIRELESS

W. R. Smijth Windham

This is not the place for wireless technicalities, but I will endeavour to state as briefly as possible what were the wireless arrangements, and what in general are the advantages and disadvantages of taking wireless on a Mount Everest expedition.

I returned to England early in December 1935, and was told to carry on with the organization of the wireless in accordance with my own ideas. I regarded the main function of the wireless as being the means of rapid transmission of weather forecasts from their source at Calcutta to those who would use them,

namely, the climbers. It will be simpler if I deal with this in three phases: Calcutta to Camp I; Camp I to Camp III, and Camp III upwards.

Firstly, I arranged for a station to be established at Darjeeling which was the nearest point in civilization with the necessary facilities. It was excellently run by two N.C.O.s (Sergt. Frawley and L/Cpl. Maudsley), and was equipped with a telegraph circuit by which weather and other telegrams could reach the station quickly, and with W/T whereby messages could be retransmitted to me at Camp I.

The plan was for Ruttledge to be at Camp III. I would have liked to be there too, but there was one big disadvantage—Camp III was liable to evacuation owing to bad weather. I chose Camp I, which is quite high enough when one considers swinging the starting handle of a charging engine on a cold morning.

The equipment at Camp I consisted of a specially modified Norman Lyon charging engine, which supplied power to a bank of accumulators presented by Messrs. Young, from which was driven an Eddystone short-wave transmitter, which put some 50 watts into the aerial on a frequency of 7 mcs. per sec. An Eddystone short-wave receiver was to receive signals both from Darjeeling and from Camp III.

So far so good. Then came the difficult problem of communication with Camp III. No member of the party besides myself had any experience of wireless. The obvious solution was a field telephone circuit, but it would have cost over £150. The only alternative was wireless, very portable wireless with limited power, probably involving the use of the key rather than the microphone. I bought a Marconi battery-driven transmitter and receiver for Camp III and a similar transmitter for Camp I, and forthwith enlisted Gavin as my disciple. He, with Ruttledge, Humphreys, and Oliver, were made to attend morse classes, and his enthusiasm was such that by the time we reached Everest he erected and took sole charge of the Camp III wireless in a manner quite above criticism. We became known to the porters as the Bijli Sahibs; the more erudite of them even used the term Wahlis Sahibs.

If all went well, our weather forecast would reach Camp III from Alipore in, say, two hours. But it would still be useless to the assault party high up on the mountain if it could not reach them by the same evening. The requirements were extreme lightness and simplicity. Fortunately these could be met by the use of wireless working on ultra-short wavelengths (5 metres). Fortunately, too, the layout of the mountain is right, for these radiations are very similar to light rays, and require a straight uninterrupted path. Sets were designed by Eddystone with an all-in weight of 28½ lbs., and two specially light ones for Camps VI and VII weighed only 15 lbs. They could be erected in about three minutes, they transmitted speech, and in use required only the operation of one knob, the send-receive switch.

I may leave to the imagination the tiresome details of packing and shipping, the harassed checking of boxes at Darjeeling, and the daily anxieties of the march, with its bumping and boring, its bucking off of fragile loads, and its muleteers who use one's petrol cans as firebricks, and pass to Camp I, where Gavin and I started unpacking on April 27. As exercise I commend to you the driving of iron mast-pickets into rock with a 7-lb. hammer at 18,000 feet.

By May 1 we were through to Darjeeling; by May 9 Gavin had worked to me from Camp III, and when Smythe and Shipton occupied the North Col they found the 5-metre wireless to Camp III as good as a domestic telephone, or so they said.

There is little more to add, save that when the party went up the main Rongbuk Glacier to examine the North Col from the west, I accompanied them with

skeleton equipment. I used the Marconi transmitter whose range is given by the makers as 5 miles. By fitting an aerial with a specially high angle of radiation I was able to send signals over the North Peak, which was immediately above us, and bounce them down to Darjeeling on the other side, 110 miles away. Reception was good, too, particularly from the B.B.C. I remember well eight of us, in my six-by-four tent, listening to every word of the commentary on the first Westchester Cup match. My point is that should the western route be decided upon as the line of attack on a future expedition, the North Face Camp will form an even better wireless H.Q. than did Camp I this year.

That brings me, in conclusion, to the pros and cons of wireless on Himalayan expeditions and on Mount Everest in particular. It is a very controversial question, but I feel it is important that a future leader should have all available information before making his decision. Taking the objections first: The wireless this year cost roughly £1000. Of this £500 was spent on equipment and the other £500 went on transport and on personal clothing, messing, fares, etc., for me. The total might have been less had I had more time in England before starting, and might have been cut down by a less comprehensive wireless plan. But one must guard against spoiling the ship for a ha'p'orth of tar. Also, I understand that the proprietors of the *Daily Telegraph* gave an extra £500, on condition that the reports from the expedition were sent by wireless, and gave £500 extra towards the cost, so that the net expenditure amounted to about £500.

Secondly, it has been and is being argued that every member of the expedition should be a potential starter for the summit: this on the ground not only of cost but also, it is said, of reducing numbers in order to make the party less unwieldy in its march across Tibet. I leave it to be decided whether the general is to go over the top, bayonet in hand; certainly if he does he need have no experts behind him, for he will have committed himself irrevocably.

Thirdly, in certain cases wireless bulletins have undoubtedly increased the anxiety of relations; but I am doubtful how much weight should be given to a disadvantage of this kind.

Now for the advantages. Is wireless useful? In six weeks I dealt with 549 messages, of which about 350 were weather messages, about 120 were on expedition business, including press, and 80 were private. This takes no account of the many messages concerning supplies and porters which passed between Camps I and III, or of tactical messages between Camps III and IV. The evacuation of Camp IV was carried out after full discussion by wireless telephone with the leader at Camp III.

Secondly, are weather messages useful? Although in a year like this they served mainly to intensify the general gloom, I think the answer must be Yes. But a word of warning is necessary here. The Indian meteorological authorities have repeatedly stressed that they cannot help Everest if Everest does not help them. Without an observatory north of the Himalaya they must rely on information from the mountain. That involves a wireless transmitter and therefore a wireless operator. Now it has been suggested that wireless might be taken without a wireless operator. In my view that would lead nowhere. If you sacrifice a wireless operator you must sacrifice a great measure of reliability not only in the actual working of the wireless, if indeed it works at all, but also in the weather forecasts, for if there is nobody to observe the Everest weather and transmit details to Alipore, Alipore in turn cannot make forecasts.

There is only one question to decide here, whether to take full wireless equipment with a wireless specialist who might well know something about meteorology too, or to take nothing at all. That is the question, and if I told you my answer you would accuse me of being biased.

APPENDIX IV: PHOTOGRAPHY

F. S. SMYTHE

Everest has been photographed so often that from a topographical standpoint little remains to be done on the Tibetan side of the mountain, though of course the scope of the stereo-photogrammetric survey of the district could be extended indefinitely. The main objects of photography are to bring back a record, personal and topographical, of an expedition in which must be included a record of the meteorological and snow conditions on the mountain.

Of recent years the development of the miniature camera which uses 35 mm. film and takes thirty-six exposures on one film has greatly assisted mountaineers and explorers to whom bulk, weight, and ease of manipulation are first essentials. The production of film of fine grain which enables such photographs to be enlarged satisfactorily to about 12 by 10 inches and reproduced as good lantern slides has rendered such apparatus and film particularly suitable. At the same time larger films are still more suitable where greater enlargements are desired, and the best camera in my opinion is the 6 by 9 cm. "Etui," which weighs only 1 lb. (as against about 2 lb. of the "Leica" type of miniature camera) and which uses film packs. The sole disadvantage of such a camera as opposed to a miniature camera is the necessity of changing film packs more frequently, a chilly operation at high altitudes and one calculated to reduce the number of photographs taken, a point lamentably evident in the few photographs taken by expeditions above the North Col.

The 1936 expedition was equipped with various cameras ranging from miniature size to quarter-plate, and with these excellent results were obtained on Kodak "Panatomic" film, a film of panchromatic quality well suited to mountain photography.

Light values are not easy to estimate, and the tendency has always been to under-exposure during the march through the Sikkim valleys, where water vapour reduces values, and to over-exposure on Everest, where the value is very high. Exposure meters are of little value owing to the varying proportion of ultra-violet light as height is gained, but it should be possible to evolve a compensating table to aid the photographer who uses a photo-electric exposure meter.

Filters are necessary during the march through Sikkim and across Tibet if the best results are to be obtained, but are not so desirable above the snow-line as they tend to over-correct sky tones. Examples of this will be found among the photographs taken by former expeditions, in which the sky appears unnaturally dark. These photographs are often effective but do not represent landscapes accurately, and accuracy is an ideal to be aimed at in photography on Everest. The best mountain negative is one not too dense and with detail present in shadows and high lights, particularly the latter if a soot and whitewash effect is to be avoided, a common failing of mountain photographs.

The most common criticism of Everest photographs is that they convey little idea of the scale of the mountain. This is inevitable but can be remedied to some extent by careful composition and the juxtaposition of a tent or human figure in the foreground or middle distance. Unless a special effect is desired or the photograph is to be purely a topographical one, a human figure does add to the interest, especially to those who have not seen Everest.

The mere pointing of the camera at a scene of grandeur and beauty, coupled with the correct exposure, is not enough, and the result is too often disappointing. Balanced composition is perhaps more important in mountain photography than in any branch of photography, and the photographer, who would like to

do justice to his subjects, would do well to spend some time studying the principles of composition; in this a visit to an art gallery is an illuminating experience, as precisely the same principles apply in landscape painting. The aim of the photographer must always be to lead the eye forward, as it were to a climax, and this is only accomplished by correctly balancing foreground with middle distance and background and by correctly apportioning sky to landscape. For instance the insertion of a single pine tree in the foreground of a mountain picture against a background of mountain transforms an otherwise dull picture into something artistic and beautiful. There are no trees on Everest, but some kind of foreground object is usually available.

Thanks to the generosity of Kodak, Ltd., it was possible this year to obtain a cinematograph record of the expedition. This was taken on supersensitive panchromatic film and the apparatus employed was a "Special Cine-Kodak," two "K" models and one "B.B." model "Cine-Kodak." In addition, a quantity of Kodak "Kodachrome" film was employed, thus enabling the first cine pictures of an Everest Expedition in colour to be obtained. Before our departure I was warned by Kodak, Ltd., not to use "Kodachrome" film where an important picture could not be duplicated in black and white, as the film was then in its experimental stage, and it was doubtful if it would remain unaffected by climatic changes, in particular the damp heat of India during the monsoon season. Some of the film was ruined by climate, but a greater proportion processed well. It was found to require a greater exposure than originally recommended, and I would now suggest an exposure of between eight and sixteen times more than that necessary for the supersensitive panchromatic film. No filter except a haze filter for distant views is required for this film and, except that it demands a greater accuracy of exposure owing to its lesser latitude as compared with black and white film, it is as easy to handle as the latter. It is also worth noting that although it is not yet possible to duplicate this film in colour excellent black and white copies can be made from it.

As regards the supersensitive panchromatic film, red Wratten filters were employed, and though good results can be obtained without them I would unhesitatingly recommend them to be used during all stages of an expedition. In this connection it should be pointed out that the quality of a cine film is necessarily somewhat different from that of a "still" film, and any tendency to over-correct skies is preferable to under-correction when the film is projected on to a screen. Elaborate apparatus is unnecessary and the numerous appliances on the "Special Cine-Kodak" were never employed. Thus the camera was unnecessarily heavy.

Telephoto lenses are essential. They enable the complimentary picture of a middle distant or distant picture to be taken, a function of all good cinematography, and the camera therefore should be fitted with a turret head so that the telephoto lens can be brought into use without delay or the necessity to fiddle with cold fingers.

The importance of a good stand cannot be over-emphasized. If it is worth taking a film at all it is worth while using a stand on every possible occasion. On a large screen, such as is employed in the Society's Hall, the slightest tremor is brought into prominence, and at high altitudes where breathing is more rapid, or after muscular fatigue when the body is unsteady, it is impossible to take steady pictures without a stand, or some form of support.

APPENDIX V: SNOW CONDITIONS ON THE NORTH COL

F. S. SMYTHE

From the point of view of danger the ascent of the North Col from the head of the East Rongbuk Glacier presents considerable problems, and a study of the history of this route shows how diverse are the conditions with which climbers must contend.

In 1921 the Col was reached without incident towards the end of the monsoon season, though Mallory in his account mentions frozen avalanche snow. In the light of subsequent experience however it is probable that the party exposed themselves unknowingly to considerable risk.

In 1922, shortly after the monsoon had broken, seven porters lost their lives in an avalanche.

In 1924 no avalanche occurred except for a minor snow slip during the rescue of some porters who were marooned by pre-monsoon snowstorms on the Col.

In 1933 the party on one occasion retreated owing to a snow formation resembling a windslab, and Camp IV, which was on a ledge some 300 feet below the crest of the Col, had to be moved on to the Col owing to the risk of an avalanche overwhelming it from above. A reconnaissance after the monsoon had broken disclosed dangerous conditions.

In 1935 a large avalanche occurred shortly after the establishing of Camp IV which involved a considerable portion of the route.

In 1936 after the abandonment of Camp IV prior to the monsoon the slope was heard to crack at one place. The same thing was heard later on another part of the slope after the monsoon had broken when an attempt was made to re-occupy Camp IV, and finally Wyn Harris and Shipton narrowly escaped disaster when an avalanche was detached during a reconnaissance of the route.

All the major avalanches so far observed on the North Col have been of the slab type. The upper stratum of snow has slid off *en bloc*, breaking up into minor blocks as it did so. This is characteristic of the windslab, for the formation of which the east face of the North Col is peculiarly suited. The prevailing wind is from the west or north-west, and even during the monsoon when the prevailing air current is from the south it would appear that it passes over the 19,000-feet Col known as the Lho La to the west of Everest and is then deflected against the west slope of the Col. Thus the snow is blown over the crest of the Col and settles on the lee side. This, though one of the conditions necessary in the formation of windslabs, is not the only condition. It has been established by scientific experiments in the Alps that a certain percentage of humidity is also necessary. Mr. G. Seligman gives this as about 85 per cent. No measurements of humidity have been taken at or above 22,000 feet on Mount Everest, but the available evidence points to the fact that whereas before the monsoon air current reaches Everest the percentage of humidity is less than 85 per cent., after it reaches Everest it exceeds 85 per cent. during the greater part of the monsoon. From this, and the evidence already known, it would appear certain that whereas it is justifiable to ascend the North Col from the east prior to the incidence of the monsoon current, it is unjustifiable to ascend it after its arrival.

The problem however is not so simple as it sounds. By "arrival of the monsoon" expeditions in the past have assumed this to mean the first heavy precipitation of snow on Everest which is not quickly removed by the north-west wind and which is accompanied by a marked rise of air temperature. From the point of view of safety or danger on the slopes of the North Col such an assumption is wrong. Monsoon precipitation may be preceded by a rise of air temperature and humidity slight enough not to be noticed by a party unequipped

The North Face Camp

with measuring instruments yet sufficient to induce avalanches. Thus, a party might continue the ascent in good conditions on the upper part of the mountain yet be overwhelmed by an avalanche on their descent of the North Col. Such a possibility makes careful observation essential, and if the same route to the North Col is to be followed by future expeditions I would strongly recommend the taking of instruments which should be under the charge of some competent person.

In 1936 I believe such conditions as already described did actually occur, as when Shipton and I made the descent of the North Col after abandoning Camp IV the snow was in a dangerous condition and on one occasion cracked ominously beneath me as I was exploring it ahead on a rope. As even a small avalanche is likely to involve a party in disaster owing to ice-cliffs which are almost everywhere below the route, no precaution to avoid such danger can be too elaborate.

A windslab is the most difficult of all snow conditions to detect. The climber is lulled into a sense of false security by apparently firm snow which may be so hard on the surface as to necessitate step cutting. Such a condition obtained when Wyn Harris and Shipton made their reconnaissance which nearly ended in disaster and the avalanche which occurred was a typical windslab. For the past few days, and particularly during the morning before this incident, a strong north-west wind had been blowing. This was sweeping the face of the North Col almost horizontally, and I for one had no fears for the party and was of the opinion that the wind so far from forming windslab was consolidating the snow into a safe crust. In this I was mistaken.

It cannot be too strongly urged that Everest climbers should visit the Alps during winter whenever possible so as to gain experience in windslab avalanches. Only through such experience is it possible to detect a windslab. A windslab can be detected both visually and by the feel of the snow. In appearance the snow is smooth but rippled by wind at the edges of the slab. In feel, though it may, as already noted, be hard, it possesses a curiously velvety texture which is particularly noticeable when ski-ing.

Though it may be safely assumed that the avalanche which nearly overwhelmed Wyn Harris and Shipton was an ordinary windslab such as is common during winter in the Alps, the far larger avalanche which occurred in 1935 was a more complex affair. The monsoon then was well advanced and air temperatures and humidity had been high for some weeks. The slab was fully 6 feet thick and covered a considerable area; the avalanche must have weighed tens of thousands of tons. During their ascent the party found the snow reasonably firm and apparently safe. The night temperature at Camp IV was low, yet the avalanche occurred, it is thought, early the following morning. Had the snow been wet and sticky the party would have turned back, for wet snow avalanches such as are common in the Alps during spring and summer are easy to detect, and the party was a competent one, and one member at least, Kempson, had had considerable experience of Alpine winter snow conditions.

Shipton's theory is that weeks of monsoon weather had rotted the snow, but this is not a sufficient explanation. It may be that the avalanche was a combination of windslab and waterlogged snow. It cannot have been formed of purely waterlogged snow, otherwise, as already mentioned, it would have been detectable and the low overnight temperature would have held it *in situ*. There is the possibility that it was detached by an abrupt movement of the ice-fall on which it rested—a possibility that deserves consideration when ascending the east side of the North Col and one which militates against this route. From the available evidence it would appear to have been of a similar type of avalanche to that which overwhelmed the seven porters in 1922, though on that occasion the

The west side of the North Col from the high camp

snow was considerably softer and the climbers were sinking several inches into it.

It is possible that the avalanche was a windslab which formed some time previously, but that it was not one which readily avalanched of its own accord. Subsequently it was covered by monsoon snow and the weight of this plus a movement of the ice-fall eventually dislodged it. I have on one occasion seen such a condition in the Alps when climbing on ski the Schilthorn above Mürren. In this case a windslab had become covered by several inches of new powdery snow. The latter appeared quite safe as it was loose and crystalline in texture. Nevertheless the hidden windslab beneath cracked, but fortunately did not come away. It is difficult to imagine any more treacherous and incalculable form of avalanche than this. Neither visually nor by feel was it detectable, and the only possible clue in dealing with such an avalanche is previous knowledge that a windslab has formed coupled with knowledge of the direction of the wind during the snowfall which resulted in the formation of the slab. Neither in my case nor Shipton's was such knowledge available, and this in itself is sufficient proof that the North Col is very dangerous during the monsoon season and should be left severely alone.

To sum up, there is no doubt that a route should be made if possible up the west face of the North Col. This face being on the windward side of the Col is certain to have safer and more easily calculable snow. Windslabs are unlikely, though it is not impossible for them to occur on a windward face. If a rock rib is followed the climber need ascend no more than 300 feet of snow, and if the worst came to the worst and an avalanche occurred he has a better chance of escape as there are no ice-cliffs below him.

It is probably more difficult than the east face and may take a longer time to force. If the next expedition arrives a month earlier at the base camp there will be ample time for this, and the ascents and descents in making the route will serve to acclimatize the party, for it is certain that acclimatization is better gained through a number of ascents and descents than through residence at any particular altitude.

This does not rule out the possibility of the eastern route. This may be assumed safe in pre-monsoon conditions except after a heavy snowfall, but a route on the west side of the Col, even if not used to the exclusion of the eastern route, would serve as an alternative route in the event of the arrival of the monsoon air current finding the climbing party on the upper part of the mountain or in position to attack at Camp III. In 1936, when much of the snow was swept from the mountain by a north-west gale after the first monsoon precipitation and the party was in the unfortunate predicament of being unable to attempt the summit owing to dangerous conditions on the east face of the North Col, it is probable that the west side of the Col was practicable.

Finally, it should be emphasized that Himalayan snow cannot obey different laws to Alpine snow, but that its study is complicated by swiftly changing and more varied conditions in which a greater range of solar temperature and changing air temperatures and humidity due to the monsoon play the principal part. And allied to these factors high winds and heavy snowfalls must be added.

I have dealt only with the practical aspects of snow conditions on the North Col and have endeavoured to outline the problem as seen from the mountaineer's standpoint. I leave those more expert than I to add to our theoretical knowledge of an intricate subject. There is a considerable literature, and I would especially bring to the attention Mr. G. Seligman's book, 'Snow Structure and Ski Fields.'

APPENDIX VI: HEALTH

DR. NOEL HUMPHREYS

The problem of climbing Mount Everest, which is really the problem of the last thousand feet, resolves itself into the double problem of health and weather. The problem of getting permission to enter Tibet, that of finding a route to the mountain, that of the organization of the expedition, have all been solved. The expedition this year went like clockwork. The mountaineering difficulties of reaching 28,000 feet had been overcome on three occasions by previous expeditions and the way beyond this to the summit has been seen and the technical difficulties are considered well within the capacity of experienced mountaineers. Of the two factors, health and weather, the latter is outside our control, but the former was a matter of great consideration by the Everest Committee and the leader of the expedition.

Whether without the aid of artificial oxygen it is possible to climb, or even remain conscious, above 28,000 feet is still unknown. From experiments in decompression chambers it is found that consciousness is lost at or before an atmospheric pressure corresponding to that height, and it may be more than a coincidence that this is the exact height at which three parties of Everest climbers have had to turn back. Some mountaineers however point out that experiment cannot exactly simulate conditions in the field. In the decompression chamber the subjects are introduced to rarefied air without previous acclimatization, whereas climbers on Mount Everest have been living for weeks at a height of approximately half that of the mountain they are on their way to attempt. Moreover it has been remarked that no Himalayan climber has actually become unconscious from the effect of height, whereas in decompression chambers some subjects become unconscious at a pressure corresponding to a much lower height than has been reached on Mount Everest. It is possible therefore that loss of consciousness in the decompression chamber is due to change of atmospheric pressure rather than the amount of pressure. Unfortunately the weather factor this year prevented the health factor, at very high altitudes, coming into play.

That there is steady physical deterioration at altitudes above 21,000 feet was the opinion formed by scientific experiment, and has been confirmed by the experience of Mount Everest expeditions, including that of this year. It is also known that simultaneously with deterioration there is adaptation to the conditions. These simultaneous processes may be compared with those manifested by the drug addict, who, while steadily deteriorating physically, is yet adapting himself to withstand the effects of larger and larger doses. The rate of deterioration would appear to be constant for any one climber at any one height, but the discovery of former Everest expeditions, confirmed by experience this year, was that the rate of adaptability could be increased. Climbers who had been on previous expeditions to the mountain acclimatized more quickly than those who were being tried out for the first time. Moreover on any one expedition each successive excursion above Camp I showed an increased speed of acclimatization.

Unfortunately there is no known method of forecasting the speed of acclimatization for any individual climber untried at great heights, and this makes the selection of a team for the expedition a difficult matter. The method adopted was first to appoint climbers who on previous expeditions had shown a good power of acclimatization to heights. For the rest of the team, from among a large number of first-class climbers preference was given to those with outstandingly good medical reports, and from among those preference was again given to those with Himalayan experience. The medical tests were made by the medical staff

of the Royal Air Force who are accustomed to make examinations with a view to ascertaining a candidate's fitness to withstand the effect of great height. After the team was selected further precautions were taken. The members were vaccinated and inoculated against typhoid. X-ray photographs were taken of their jaws in order to detect any latent abscesses, at the apices of the teeth, which might flare up when vitality was reduced by living at a great altitude. A number of teeth were extracted as a result of the X-ray reports, and this treatment would appear to have been justified as only one tooth had to be extracted during the expedition and this from a member who had joined from abroad and so escaped the careful examination of candidates joining from England. Among the Europeans there was only one case of serious illness: benign tertian malaria, which was successfully treated.

The medical equipment taken was based on the experience gained on previous Everest expeditions and was ample and comprehensive. Surgical instruments were taken which would enable us to perform major operations, if necessary. The size of our medical equipment was influenced by our intention of doing what medical work offered among the native population of Tibet, and this work took up a good deal of the time of the medical officers, but was very satisfactory in the goodwill it occasioned. On the march over Tibet there was almost no sickness among the members of the expedition. There were certain alimentary disturbances, occasioned probably by mica in the drinking water. A few of the Europeans suffered very slightly from mountain sickness when first reaching the plateau of Tibet. Sore throats started before we reached Base Camp. At Camp III however the effects of height were felt by every member of the expedition, who all suffered from some of the following complaints: headache, sore throat, breathlessness, lassitude, loss of appetite, nausea, vomiting, insomnia, indigestion, diarrhoea, and such visual disturbances as diplopia and "blacking out." These were the effects of height on exceptionally healthy people. Few complaints could be treated successfully. Headaches yielded to aspirin, and insomnia to chloral hydrate, but no treatment was successful with the throats, many of which were badly ulcerated.

Whenever it seemed that the snow conditions on the North Col would prevent useful work from Camp III, the expedition was withdrawn to Camp I where an improvement immediately set in. It was very noticeable that each time the expedition returned to Camp III acclimatization was more rapid. After our final retirement from Camp III muscle wastage was very marked, and even the 250 miles' march back to Sikkam left our muscles smaller than when we had entered Tibet, three and a half months before.

APPENDIX VII: PHYSIOLOGY

C. B. WARREN

The journey up to the higher camps on Mount Everest calls forth individual physiological adjustments which are of peculiar interest not only for study, but also for the practical bearing which they have upon the success or failure of the whole venture. It is coming to be realized that the climbing of the mountain is now almost as much a physiological problem as a mountaineering feat. Questions which still have to be answered are: At what altitude does deterioration set in? Does further acclimatization take place above the level at which the body shows signs of deterioration? Is it possible to climb to 29,002 feet without using oxygen?

As a result of experiments with animals which were kept at low atmospheric

pressures for a considerable time, Sir Leonard Hill and Argyll Campbell came to the conclusion that it was useless to attempt to acclimatize to altitudes greater than 21,000 feet; above this altitude their animals eventually died, and when examined were found to have dilated hearts and fatty degeneration of all their organs. As a result of experience gained on the last three expeditions we are coming to acknowledge that the physiologists may have been right after all when they put the greatest altitude at which man can live and thrive at this same level; for since the expedition of 1933 it has become a principle that the longer a climber is kept above Camp III (21,200 feet) the more does he deteriorate.

In these circumstances it may not be out of place to reconsider the whole problem from the physiologists' point of view, and to consider once again whether their advice on the matter of oxygen should not be given greater consideration in the future.

The first stages of the march to the mountain carry one steeply and rapidly from the plains of India to the high Tibetan tableland; there is a rise of some 16,000 feet in the first 70 miles. During this period of the expedition the more acute signs of mountain sickness are likely to be prevalent, and these are—shortness of breath and a feeling of suffocation on the slightest exertion, blueness of the lips, ears and fingers, headache, and vomiting. At such a time the emergency methods of acclimatization are being brought into play, but the slower and more permanent adjustments, such as the increase in the red cells of the blood, have not had time to come into action.

Both this year and during the Reconnaissance of 1935 it was noticeable that people suffered from the altitude most acutely on reaching Tangu. In a report on "The Medical Aspects of the 1935 Reconnaissance Expedition" I said: "At Tangu (12,000 feet up) frequent are the records of distress in the visitors' book left by parties visiting the bungalow and passes in the neighbourhood. And our own experiences showed that even those accustomed to such changes can succumb: for all seven members of the expedition suffered in varying degrees from symptoms which were due to the altitude." And this year the only place at which vomiting occurred as a symptom due to altitude was Tangu. Here we waited for several days before tackling the pass (Kongra La, 16,000 feet) into Tibet, with the result that we presented a far less pitiful spectacle than the party of 1935 did when making the same crossing.

Once the pass has been crossed the route to the mountain runs for some 200 miles across comparatively level country, but all the time at altitudes greater than 13,000 feet. Here conditions are ideal for stimulating more permanent acclimatization. In most members of the party the blood count had increased by at least 20 per cent. before reaching Base Camp (16,600 feet), and in some cases had even advanced to 30 per cent. above the normal level. And with the advent of these changes had come relief from the urgent symptoms: the lips were no longer livid, our headaches passed away, and the breathing was no longer deep and rapid and there was no longer a feeling of suffocation on exertion. Indeed we arrived at Base Camp feeling almost as well as at sea-level; in fact Wyn Harris, who had come straight from Africa to join the expedition, was a great deal fitter on arrival at Base Camp than he was when he started from Gangtok.

A characteristic which has been described as being peculiar to native peoples who dwell permanently at high altitudes is the shape of the chest, which is deeper and of greater capacity than that of persons living at sea-level. A greater capacity of the chest would mean that a greater area of the lung was exposed to aeration. In order to see if our own lungs increased their capacity as we went

higher we measured the vital capacity of the lungs. To do this the subject is instructed to inspire as much air as possible. When his chest is full to bursting point he is made to blow out the air into a gas meter until he can expel no more. The volume of the gas expelled is measured by reading a dial. In some members their vital capacities had increased by the end of the expedition by 27 per cent. This is another of the slower adjustments by which acclimatization can be assisted.

It is obvious that there is a limit to such processes as that just mentioned, and it is of importance to us to try and discover the altitudes at which these compensatory processes are still taking place, and where they cease. It is also important to know just where the destructive processes of deterioration begin to set in. Is acclimatization still going on when this happens?

After the first attempt to get above the North Col this year we all retreated to Camp I after being up at Camp III for a period of eleven days because it was thought that the strength of the party would improve with a period at a lower level. Morris and Smijth-Windham were both at Camp I, and they told me afterwards that we all looked thin and ill when we first came into camp. It was also noticeable that people began to eat with their accustomed appetites as soon as they got down to 17,700 feet at this camp. In every case except one there had been a loss in weight, though this was much less marked than in 1935, when we spent longer above this altitude. In 1935 there was even a gain in weight, in one instance as much as 9 lb., after five days spent at Rongbuk.

At Camp III sore throats were prevalent, and on retreating to lower levels there was generally a marked improvement in these, though they did not in most cases clear up completely.

From all Mount Everest expeditions there have been reports of altitude sore throats, and both this year and last year, at one time or another, almost every member of the party suffered. From the point of view of keeping the climbers fit for their task the problem of their prevention is a major one. There is no doubt as to the cause of the condition. Normally the throat and nose contain bacteria which are harmless: the "normal buccal flora." But by breathing the unusually dry air of the north side of the mountain through the mouth instead of the nose (for when you are panting for breath mouth-breathing is the rule) it escapes its one chance of being moistened, and the result of this is that the cells lining the upper respiratory passages over which it passes become dried up. In this state they are liable to invasion by the normal buccal flora. In some cases the throat was actually ulcerated; whilst in most instances the sufferer was left with an irritating cough. With Shipton the infection spread to his larynx, so that he lost his voice and could only issue orders in a hoarse whisper. There was a noticeable improvement in the sore throats as soon as the moisture-laden clouds of the monsoon began to pour over the passes on to the East Rongbuk Glacier. When climbing in Garhwal on the southern slopes of the range these throats were not a common feature of life at high altitudes.

The application of liquid paraffin with a spray so as to form a protective film over the throat would seem to be a rational form of treatment, but this was tried and found to be inadequate. The best method to insure that the air breathed was properly moistened would be to wear a mask of the Matthews' respirator type when taking exercise high up. With this mask the moisture in the expired air is condensed on a pad of copper gauze, and with inspiration the air taken in is moistened and at the same time warmed by passage through the gauze. It would only be a matter of training to get used to wearing the respirator; it need not be worn all the time.

What further evidence have we that deterioration may be taking place at

21,000 feet? The pulse rate may give us some indication as to what is happening. The "basal pulse rate" is the number of beats per minute of the pulse when taken the first thing in the morning with the subject lying quietly in bed. In normal circumstances the frequency remains very constant for each individual. Any effort, such as turning over in bed, will send the rate up. It was found that in only two of the eight climbers tested was there no appreciable increase in the basal pulse rate up to altitudes of 21,200 feet. In five out of eight the frequency was constant below 17,700 feet (Camp I). And in one of the eight it was constant below 16,600 feet.

This year no one was exposed to the strain of going really high, so dilated hearts were not to be expected. Only once was the whole party examined, and that was after coming down from Camp III for the first time. On that occasion there was no evidence of strained hearts. But when going back up to III later on, at a time when I was ill with a sore throat, I did notice that my own heart was making extra beats.

So much for altitude deterioration. Have we any evidence that acclimatization is still going on at 21,000 feet? To begin with, let it be said that we all felt much less distress when at Camp III on our second and third visits than we did the first time up there. Our only other evidence is derived from the blood counts. Between the time of our first visit to Camp III and our final return to the Base Camp at the end of the expedition there was in most cases further increase in the red cells and the haemoglobin content of the blood. So this much at least can be said, that our later stays at 21,200 feet did not prevent the blood count from continuing to rise.

In conclusion, the evidence which points to deterioration taking place at 21,200 feet is: Loss of appetite, with wasting and loss of weight which is rapidly regained on going to lower levels; an increase in the basal pulse frequency which is only present above 16,600 feet; in animal experiments, the inability to prevent them from ultimately dying with fatty degeneration of their organs; and possibly the occurrence of undetected extra systoles of the heart.

And that which would lead us to believe that some acclimatization is still going on is: That the climbers were less distressed on their later visits to Camp III, and that living at Camp III did not prevent a further increase in the red cell counts of our blood.

APPENDIX VIII: THE OXYGEN PROBLEM

C. B. WARREN

The carriage of oxygen in the blood and its function

When a man goes to a high altitude he has to breathe an atmosphere which contains less oxygen than there is at sea-level, though the proportion of oxygen to nitrogen remains the same: that is, oxygen still forms 20 per cent. of the atmosphere. What has altered is the barometric pressure, so that the pressure exerted by each of the gases composing the atmosphere has altered also. Oxygen passes from the air in the lungs into the blood, which is circulating through those organs as a result of the pressure exerted by the gas. The amount taken up depends upon the pressure at which the gas is delivered to the blood. If the partial pressure of oxygen in the breathed air is reduced as it is at high altitude (and in low-pressure chambers at sea-level), then less of it is taken up, the blood leaves the lungs less fully saturated with the gas and so has less to deliver to the tissues. The tissues must be supplied with oxygen at a definite pressure if their life and function is to be maintained. It is lack of oxygen to the tissues which

gives rise to symptoms, and which calls forth the adjustments which are made by the body in order to adapt itself to the new environment. When the partial pressure of oxygen in the breathed air is reduced beyond certain limits, symptoms which have nothing to do with the bodily adjustments, but which are directly attributable to the diminished pressure, are met with. For instance, if an airman rapidly goes to a great altitude he will lose consciousness without warning. The same thing happens if he is put into a closed chamber at sea-level from which the air is rapidly exhausted.

In 1875 Tissandier and his companions made their famous ascent in a balloon from Paris. At 26,500 feet Tissandier lost consciousness. He recovered to find the balloon descending, but his two companions were dead. It has been suggested that such an accident might happen on Everest if a climber went beyond the present highest point reached. But I do not think such a thing would be possible when we consider what happens when the oxygen pressure is reduced more slowly. He is more likely to be exposed to another kind of danger. With a more gradual onset of anoxia the train of symptoms is as follows: The intellect and the senses become dulled without the subject being aware of what is happening. Visual acuity is diminished and sensation impaired. The subject may be in danger and not realize it; or he may realize his danger and yet be incapable of deciding upon a line of action which would put him in safety. Finally there is paralysis of the legs and arms, and ultimately loss of consciousness. On the extreme heights of Everest the climber is likely to be brought to a standstill by the fatigue in his muscles (or if you like actual paralysis) long before he would lose consciousness. He would however be exposed to dangers due to mental impairment, such as the failure to realize the danger of his position and carelessness in his movements on difficult ground. Apart from the fact that it may not be possible to reach such an altitude as 29,000 feet without oxygen, I think that the dangers consequent upon mental impairment form the strongest argument in favour of its use on the last lap.

The apparatus, and its use on the mountain

Whatever the type of apparatus used, its object is to increase the pressure of oxygen in the alveolar spaces of the lungs. This object can be achieved in one of two ways.

In the original types of apparatus the outside air was breathed from a bag to which oxygen gas was added from a cylinder at a fixed rate. The disadvantages of such a method are that much of the oxygen is wasted by being expired from the dead spaces of the lungs into the outside air; that there is an uncomfortable drying of the throat; and that moisture and heat are lost from the body in the breath. That the apparatus is wasteful of oxygen can be seen from the following: In order to put up the partial pressure of oxygen in the air at 30,000 feet from 53 mm. of mercury to 110 mm. it can be calculated that oxygen must be supplied at the rate of 9 litres a minute. Now a partial pressure of 110 mm. of mercury is equivalent to an altitude of about 12,000 feet. So in order to bring a man down to this level it would be necessary to supply him with oxygen at this rate. But the body only uses oxygen at the rate of 0·5 a litre per minute at rest and 2 litres per minute (perhaps a little more during severe exercise) during exercise.

An apparatus of this type was taken out this year. It contained two cylinders of "vibrax" steel, each containing 750 litres of oxygen, and the reduction valve was set to deliver 6 litres a minute, though it was capable of adjustment to deliver any other quantity. With such an apparatus the supply then was 1500 litres, and this delivered at a rate of 6 litres a minute would last for just over four hours. Its weight was approximately 30 lb.

In another type of apparatus, instead of air being breathed to which oxygen is added, oxygen only is breathed and the carbon dioxide in the expired breath is absorbed by passing it through a canister containing soda-lime. The breathing circuit is completely enclosed, so that nothing is exhaled into the outside atmosphere. Such an apparatus is similar to that used in rescue work down coal mines and in submarine-escaping apparatus. Its advantages would seem to be that no oxygen is wasted, that heat and moisture are not lost by breathing into the external atmosphere, and that the pressure of oxygen breathed is the same as that of the external atmosphere (*i.e.* approximately 250 mm. of mercury at 30,000 feet), a pressure which is well above the partial pressure of oxygen in the atmosphere at sea-level.

The apparatus therefore should theoretically bring the climber at 30,000 feet down to sea-level conditions.

Such an apparatus was designed and made for us to use on the mountain this year by Siebe Gorman, the well-known firm of submarine engineers. Two sizes of this apparatus were taken. The smaller of the two weighed 25 lb. and carried a cylinder made of vibrax steel of 500 litres capacity. If oxygen was being used by the body at the rate of approximately 2 litres a minute, as it might be during muscular exercise, this supply would last just over four hours. The larger apparatus weighed 35 lb., carried a cylinder of 750 litres capacity, and on the same basis would provide oxygen for a period of six hours. The reduction valve in this breathing gear was set to deliver half a litre a minute, or the amount of oxygen required by the body when at rest; but by means of an automatic valve a greater supply could be released from the cylinder as required during exercise.

The re-breathing apparatus has been criticized on the following grounds: that there is no advantage in bringing the climber down to sea-level conditions, nay, such a change may even do harm; that soda-lime absorbs moisture, so that there is a loss of fluids from the body through the breath; and that nobody would tolerate having a mask over their face at 28,000 feet. In answer to such criticisms I would first of all point out that the most important means of acclimatization in the body is the increase of the red cells and haemoglobin in the circulation, and in the acclimatized person, even on coming down to sea-level quickly, it is a matter of weeks and not days before his blood count begins to fall. If this then is the case it seems unlikely that, by breathing oxygen at the normal pressure for a few hours on end, his acclimatization would be seriously affected. I can see no reason why he should be any the worse after wearing the apparatus, except possibly subjectively and by contrast. Then with regard to the moisture which might be absorbed by the soda-lime, it must be remembered that the patent absorbing materials such as "protosorb" (which was used in this apparatus) are frequently used nowadays in oxygen tents, and for this reason are designed to be practically non-hygroscopic. And lastly, as far as the intolerance to a mask over the face is concerned, the reply is: that with the proper oxygen supply given by such an apparatus the climber would not be at 28,000 feet but at sea-level, and that we found that after a very short time with the apparatus we were perfectly well able to tolerate it. Furthermore it may even have an advantage in that it protects the face from the wind. This year the all-enclosed breathing apparatus was tested both at home in the low-pressure chamber and in Tibet on the mountain. The trials at home were not as thorough as was desirable on account of the limited time at our disposal, and those on the mountain were not made at a sufficiently high altitude to warrant any important conclusions being drawn from them. But this much should be stated, that it was used once on the North Col slopes and resulted in a complete disappearance

of the usual muscular fatigue and lassitude which are usually experienced at such an altitude. Furthermore it was worn by several of us to make ascents of over an hour's duration above base camp, and we none of us suffered any ill effects when it was taken off at the end of the trial. And at Tangu, before any one was properly acclimatized, I used it to climb for at least 1000 feet up the hillside behind the bungalow, and yet with 35 lb. on my back I was able to climb much more rapidly than two of my companions who were going without it. Because of these remarks I do not wish it to be thought that I advocate this as the ideal apparatus, though it does seem to me to offer advantages over anything so far produced. If one has got to carry 30 lb. on one's back up the last 1000 feet, why not carry an apparatus which is going to produce maximal efficiency? But must such an apparatus weigh 30 lb.? I think that, given more time, the weight as it stands at present could be reduced considerably without changing the principles on which it works.

The final question which arises is how should the apparatus be used on the mountain? Personally I think that to try and make the ascent with it from below Camp V is impractical; I would favour its use on the last lap only. It has been suggested that oxygen might be used in camp and at night only, in order to do away with deterioration. In principle this sounds all right, but I do not think that in practice one could tolerate sleeping in it. Furthermore, if one really believes, as some of us who consider the matter from the physiological as well as the mountaineering aspect do believe, that it is impossible for a man to reach 29,000 feet without artificial aid, then such a method of administration achieves nothing towards the attainment of the summit.

A point which requires consideration is whether a six hours' supply will be sufficient to carry a climber to the summit and down again from the highest camp. Shipton has estimated that without oxygen the last 1000 feet will take about sixteen hours. Now even with 30 lb. on one's back it should be possible to climb at the rate of 500 feet an hour over quite difficult ground when at moderate altitudes. We know that this can be done in the Alps, and in the Himalayas I have climbed up difficult rocks at 21,000 feet with a 20-lb. rucksack on my back. If we can perfect an oxygen apparatus, then, which will bring the climber down to sea-level when on Everest, even though it does weigh 30 lb. and has only a six hours' supply, he should be able to get up and down again within this time, always provided that the rock climbing above the couloir is not supremely difficult, and that the first part of the route has been properly explored by a preliminary reconnaissance party, perhaps equipped with oxygen also, so that no time is wasted in route finding. But in any oxygen attempt two things must be borne in mind: that the climber must turn back in time to allow enough oxygen for the descent to the highest point he has been able to reach without it, and that twice as much oxygen is used during climbing as when descending, so that the cylinder should be one-third full when he starts to come down.

APPENDIX IX: COLLECTING

Dr. Noel Humphreys

When we left Sikkim on March 19 it was early spring. Willow, daphne, magnolia, primula, and other plants were already in flower. Reaching the tableland of Tibet however we dropped back into winter and with the exception of one species of very small primula we were not to see another flower until a month later. Tibet was frost-bound and wind-swept; honey-coloured plains with distant indigo hills, steely-blue sky and curiously opalescent atmosphere. Not

a blade of green vegetation was to be seen. On April 17, marching to Kyishong, we saw a butterfly, but we saw no more until May 20 on our return from Camp III to Camp I. By this date the vegetation in the neighbourhood of the camp was green, but as yet no flowers were out. On May 25 the first flower was seen, a saxifrage, and two days later a primula was found in flower. From then onwards most days, when the ground was free from snow, yielded a new flower. Insects and spiders became common, and during the few days before we returned to Camp III we took the opportunity to make such entomological and botanical collections as were possible.

Our next opportunity of collecting was at Lake Camp by the West Rongbuk glacier, which we reached on June 8. This was at an enchanting spot with level green turf, a lake and a winding stream. The turf was, as far as we know, an isolated patch; we had seen no other turf above Chödzong. It was at Lake Camp that the lark's nest was discovered, perhaps the highest nest that has ever been found. Here we were able to make a small collection of plants and insects, though there as yet few flowers were out. A small meconopsis was much in evidence but was nowhere more than in bud. It was at this camp that we started plants growing in boxes. These had to be roped for lifting and for transport as porter-loads and, later, by pack animals.

Once the attempt on Everest was abandoned it was decided that the whole expedition should return to Sikkim as quickly as possible so as to save the expense of a prolonged stay in Tibet. We returned therefore by double marches, travelling up to 25 miles with an ascent of 4000 feet in a day's journey. Collecting was difficult on these journeys as the baggage often arrived after dark, and even then there was delay before tents could be erected. In the evening there was almost invariably a strong wind which made it impossible to press plants or write labels in the open, and in the only tent available there was not room to kneel upright. A constant source of worry was the boxes of growing plants. These were often kicked off the pack animals or crushed, or the contents of the boxes shaken loose. Such boxes had to be re-planted next morning during the short time while it was light before the pack animals started off. Even when Sikkim was reached the plants needed constant care until they were delivered to the Royal Botanic Garden at Edinburgh.

Seeds were collected whenever possible, but these were even scarcer than flowers. Among the few we found were the previous year's seeds still clinging to a clematis which appeared to be the only species of climbing plant in the part of Tibet that we went through. This plant we afterwards saw in flower and there were three forms, apparently co-specific, with flowers nearly black, yellow, and bronze. One of the first shrubs we encountered on our way back was a rose with sweetly scented cream-coloured flowers, and lower down we found the plant in fruit and were able to collect seeds.

All too soon we reached Sikkim and our collecting stopped. We had been racing home just as the Tibetan flora was coming into flower, and it was tantalising to leave behind us most intriguing plants which some of us would never see except in bud.

DISCUSSION

Before the paper at the Afternoon Meeting the PRESIDENT (Professor HENRY BALFOUR) said: It is an extreme privilege on the first occasion on which I take the chair at a meeting of this Society to find that the lecture we are about to hear is of such importance and great general interest. I feel tempted to refer to the high honour which has been conferred upon me, but as chairman of the meeting it

is my duty to further the proceedings and not to delay them. So without even the usual preamble I will proceed to the business in hand.

Mr. Hugh Ruttledge is already well known to the Society not only for the work that he has done in the Himalaya and on Mount Everest, but also as one of the Society's Gold Medallists. That in itself is sufficient introduction.

Without delaying proceedings further I will ask Mr. Ruttledge to give his account of the latest assault upon Mount Everest.

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

The PRESIDENT: Mr. Smythe has a few supplementary remarks he would like to make with regard to the photography and the snow conditions, of which he made a special study.

Mr. F. S. SMYTHE: I would like to preface my remarks by acknowledging the expedition's debt of gratitude to Messrs. Kodak, who supplied the film you have seen and the apparatus with which it was taken; also the still films which we used on the expedition. The film was super-speed panchromatic, and you have just seen the Kodachrome film. It is necessary to give the latter about four times more exposure than the ordinary super-speed panchromatic film.

(Mr. Smythe then dealt briefly with snow conditions on the North Col. See Appendix V.)

Mr. W. R. SMIJTH-WINDHAM: Having been on two expeditions, that of 1933 and this year's, both led by Mr. Hugh Ruttledge, I want to start by saying how extremely fortunate we were as a party to have him as a leader. I am sure that the Mount Everest Committee will have an exceedingly difficult task to find another of his calibre to lead a future expedition, but I wish them luck.

(Mr. Smijth-Windham then gave an account of the problems connected with wireless arrangements on the expedition, treated in Appendix III.)

The PRESIDENT: I would have liked very much to invite onto the platform all the members of the expedition, not only for the sake of hearing what they can tell us in regard to details, but also for the sake of seeing them as they really are. You have seen them on the film and in the photographs, and three of them have revealed themselves on the platform. As far as I can make out there is a good deal of difference between the two versions. I must however bring this interesting meeting to a close. I should however like to say that, as a result of the account to which we have listened, it appears clear that for the future we can rely perfectly upon physique, endurance, pluck, mechanism, and all those other necessaries without which success cannot be achieved. There is one great problem however still to be solved, which I suppose will remain the principal crux, that is weather-conditions. But if the last expedition, like the previous expeditions, has ended in disappointment to those who have taken part in it and who have been robbed of success, at least one can say very definitely that Mr. Ruttledge and his colleagues have added several important rungs to the ladder which eventually will lead to the top. On this account, for the work which they have done with so much enterprise, pluck, and endurance, I am sure you will like to express your thanks to them; and to Mr. Ruttledge in particular, for having given us this lucid, straightforward account of the events of the expedition.

Before the paper at the Evening Meeting, the PRESIDENT (Professor HENRY BALFOUR) said: We have an extremely interesting evening in front of us, and I am not going to delay the proceedings by making any preliminary remarks. It is of course quite unnecessary for me to introduce our lecturer. Mr. Ruttledge is thoroughly well known to all of you by name and to a great many of you personally. As a Gold Medallist of the Society he is guaranteed. I call upon

him to give his account of the last expedition which has aimed at the conquest of Mount Everest.

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

The PRESIDENT: I ask Mr. Smythe to continue his remarks and particularly to tell us something more with regard to snow conditions.

Mr. F. S. SMYTHE said: I should like, first of all, to say how great was the privilege of again serving under Mr. Ruttledge. You have heard a great deal about our unworthy selves, but he has given very little idea about himself. I do not think that any leader ever had a more unpleasant task than Mr. Ruttledge this year, because he had to exercise that judgment and discretion in the face of adverse circumstances which is so difficult when conditions seem possible and yet are unjustifiable. That always seems to me to be the test of leadership, and this is the second expedition that Mr. Ruttledge has brought back to England alive.

(Mr. Smythe then resumed his account of his observations of snow conditions on the North Col, printed as Appendix V.)

The PRESIDENT: You would, I think, like to hear something with regard to the medical side of the expedition, so I hope that Dr. Noel Humphreys and Dr. Warren, the medical officers with the expedition, will add a word or two.

Dr. NOEL HUMPHREYS described the precautions taken to secure the health of the expedition and their success (see Appendix VI). He continued: We were ready for any emergency, but nothing happened, or almost nothing. This may of course have been partly due to all the precautions taken. We were however very anxious to show our skill, and about the middle of the expedition at Camp I we thought we had an opportunity. One of the porters was found groaning and curled up round a stone. He could not be straightened out because he was in such pain. He was examined carefully by the medical staff, who thought it a very serious case. We called for volunteers to go up to Camp II to bring down surgical appliances. The man passed into a state of coma. The surgical equipment came down in the middle of the night, but it was then too dark to operate, At the first grey light of dawn I went to see the patient. He was not there. Fearing that we might stop him, he had got up early to carry a load to Camp II, and was already on his way.

Dr. C. B. WARREN: As far as the physiological side of the expedition is concerned I might mention that the only word that was taboo from the start was "deterioration." We have heard a great deal about it in the past, and I think that what was said after the 1933 Expedition was probably true: up to altitudes of 21,000 feet one can remain comparatively well, eat well and sleep well, and not lose weight. Once one gets above 21,000 feet one begins to go downhill gradually, to lose weight and appetite, besides other minor happenings.

(Dr. Warren then discussed the physiological side of the expedition and the problems involved in the use of oxygen, as set out in Appendices VII and VIII.)

The PRESIDENT: I hope Sir Percy Cox will add a few words. He is Chairman of the Mount Everest Committee.

Sir PERCY COX: I feel great compunction, after we have listened with the liveliest interest to the leader's account of the expedition, to come on to the platform and turn to the dry bones of Committee business.

As many of you know, from the birth of the Everest ambition there has existed what is known as the "Mount Everest Committee," composed of representatives of the Alpine Club, the Royal Geographical Society, and, latterly, of the Himalayan Club. The functions of this Committee have been to seek the necessary funds for the expedition in view and to supervise the business affairs connected

with the organization of it. In so doing they clearly take a good deal of responsibility. The Committee, in name, remains permanently in being: that is to say, it is a standing committee, and when, after an interval, which may be short or long, fresh permission is received for another expedition to enter Tibet, the personnel of the Committee is reconstructed and it starts functioning again. I was nominated to the present Committee as a representative of the Royal Geographical Society, and, I suppose in deference to my grey hairs, I was asked to take the Chair; so that I have been closely associated with the affairs of the present expedition from the start.

The first duty of the Committee, apart from getting to work to collect funds—and a large sum is needed for a properly equipped expedition—is to choose a leader and allow him to choose his team, subject of course to the concurrence of the Committee. On this occasion the Committee invited Mr. Ruttledge to lead again, and as leader he chose his team. I am bound to say that I do not think we could possibly have had a better or more satisfactory leader or a finer team of young climbers. Unfortunately, as you have heard, we had no luck with the weather and again we did not succeed.

When the business of this expedition is wound up the present members of the Committee will, as I have explained, disperse, and the Committee will be reconstituted by the bodies represented, as soon as permission to go to Tibet is again granted.

We are of course always in a state of chronic hope of receiving such permission, but it may be a year or it may be ten years before it comes; so that anything I say now does not commit the next Committee in any way.

I would like here to pay most grateful tribute to all the Services or Departments of State who have given us most cordial co-operation. The Royal Air Force gave us the benefit of their exacting medical examination of all the candidates, and also allowed us to send the members of the team to Farnborough to be put through their high-altitude tests. The War Office were extraordinarily helpful in making it practicable for officers to obtain leave to join the expedition, and even when possible to spare them on duty.

The India Office, the Viceroy, and the Government of India have all vouchsafed us the most sympathetic co-operation all through, and I cannot be too expressive of the profound gratitude which, as a Committee, we feel towards the Government Departments for the help we have received from them.

As regards Mr. Ruttledge, the despatches which he sent home periodically during the course of the expedition were excellent and his judgment as leader, in the very difficult circumstance of failure and not of success, has been thoroughly sound throughout, and the Committee are most grateful to him for the way in which he led the expedition.

Let me now congratulate him on returning with his team complete and all well, and may I assure him that I, at any rate, feel honoured to have been associated, as Chairman of the Committee, with the expedition of this fine team. Nothing more could have been done than was done to achieve success, and it was solely the bad luck in the weather which denied it to them.

But I devoutly hope that I may live to see the mountain conquered, and there is another man here to-night, Sir Francis Younghusband, who, I am confident, feels the same.

The PRESIDENT: It is now, I regret, necessary for me to bring these proceedings to a close. We have had a most interesting evening and have listened to an account of a very strenuous endeavour to effect the conquest of Mount Everest, which has been an objective for so long. Again that attempt has not met with the success which it deserves, but if those who took part in the adventure feel

disappointed at the result, they can at any rate feel proud of having added considerably to the knowledge and experience which will eventually bring success. The experimental work has continued. We know more about the human physiological reactions. We know more about the necessary instruments which ought to be carried, and more about the snow conditions. Very probably the only factor which prevented success was the weather, which has been behaving throughout like a grim and vigilant duenna keeping watch and ward over her protégée, the virgin peak of Everest. The main problem in the future will be how to circumvent, or perhaps catch napping, that stern duenna.

Amongst the factors which will always be instrumental in bringing about final success are those absent heroes, the Sherpa porters. It is not possible to speak too highly of them. In asking you to show your appreciation of our lecturer and of his companions on this expedition, I would ask you to put in an extra round of applause for those porters.