MOUNTAINEERING ART

Harold Raeburn

THE SEA OF ICE AND THE GRANDES JORASSES.

MOUNTAINEERING ART

BY

HAROLD RAEBURN

WITH DIAGRAMS AND ILLUSTRATIONS

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TO

W. N. L.

CLIMBING COLLEAGUE

IN THE SOLUTION OF SOME SEVERE PROBLEMS

OF

MOUNTAINEERING ART

INTRODUCTION

Mountaineering is the art of getting up and down mountains. The master of the art is he who can make his ascents in good style, with ease to himself, and with safety to his companions. The whole art of mountaineering is one not easy of acquirement, or to be mastered in one or two seasons. It must always be the outcome of long practical experience, united to natural aptitude. The art cannot be properly acquired from the pages of a book. Precept is nothing without practice; the sole superiority, in most cases, of the professional guide is constant practice. The best method for a novice to learn is to watch an adept at work. Nevertheless, a great deal may be learned about equipment and technique from the printed page and the illustration. In this volume an endeavour has been made, to trace and indicate the broad principles of climbing and mountaineering, from "bouldering" to the conquest of the highest summits of the earth.

The book is the outcome of more than twenty years' experience as a climbing leader in many parts of the Asio-European continent, and on almost every kind of rock, snow, and ice formation. In preparation for it, almost every published work on climbing and mountaineering, in English, and in the principal continental languages, has been consulted. If the notes and advice contained in my book are found of assistance in the equipment of the ideal mountaineer, the safe one, the author's aim will be fulfilled.

I wish here to express my thanks for the assistance received in acquiring the information contained in the

following pages. These friends, to whom I am indebted, are too numerous to mention by name. They are, everyone who has ever climbed with me. I must, however, mention the five literary sources from which greatest assistance has been derived. These are, in the first place, the article "Snowcraft in Scotland," by W. W. Naismith, in the *Scottish Mountaineering Club Journal* for January 1893, the Badminton volume on *Mountaineering*, edited by C. T. Dent, 1892, *Mountaineering*, by Claude Wilson, 1893, the article "Technique" by M. Maurice Paillon in the *Manuel D'Alpinism*, 1904, and *Die Gefahren der Alpen* by Dr. Emil Zsigmondy, 1885.

For kind assistance with the illustrations, my thanks are due to Messrs. J. R. Young, Eric Greenwood, R. Adam, A. R. Thomson, A. E. Robertson, and to Miss Ruth Raeburn for photographs, and to Mr. Shirley B. Ralston for the line drawings.

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MOUNTAINEERING ART

CHAPTER I

HISTORICAL

The mountains, like the oceans, have always been the home of the marvellous and the terrible from the earliest dawn of history. Man, in the main, was, and still is, an inhabitant of the flat, and fat, places of the earth. The mountains, with their mysterious, inaccessible white pinnacles, behind which rose and set the sun, were the regions where he could hardly help placing the homes of his earliest gods. These were the powers of Nature made manifest. We can trace this idea in all the earliest religions, and in the more primitive regions, and amongst the more primitive peoples, this idea still prevails.

To the foot of the greatest mountain on the globe, Chomokankar (Everest), come every year crowds of Tibetan worshippers. The second world-peak, Kangchenjunga,[1] is similarly resorted to by Sikkim pilgrims.

The greatest mountain on the North American continent, Denali,[2] means, The Great One. Its former Russian name, Bolshoi Gora, is a translation of the native name. The beautiful isolated snow cone of Tacoma,[3] which rises above the waters of Puget Sound, has been described in a finely illustrated volume as, *The Mountain that was God.*

The Japanese, an idealistic as well as a practical

[1] K2 is probably lower. See Burrard and Hayden, *A Sketch of the Geography and Geology of the Himalaya Mountains* (Calcutta, 1908).

[2] Mount McKinley.

[3] Mount Rainier.

people, give a prominent place to the respect and worship of mountain nature and mountain gods. The great volcanic cone of Fuji San is yearly ascended by upwards of 15,000 pilgrim climbers.

In the Himalayas almost every commanding summit at the head of each great river is held in sanctity by the peoples of that valley or draws its worshippers from even farther off.

In the Caucasus, also, rises the sacred mountain of Mquinvari, the Kasbek[1] of the Russians, the traditional scene of the martyrdom of Prometheus, the human hero who first dared to wrest from nature's gods the secret of fire. Mquinvari looks southward, over the central Colchian depression, to another sacred volcano, Ararat, on whose summit rested the Ark, and in whose neighbourhood rise the head-waters of the streams which watered the Garden of Eden.

All round the globe we find the mountain worshipped: as material objects no doubt in many cases, but underlying this is a notion, often vague perhaps, of spiritual forces. In the Alps, also, numerous traces of these ideas are to be found.

These ancient deities were not by any means merely terrible, or wholly "adversaries." They were aiders and benefactors, as well as rulers and destroyers of men. As time passed, these ancient semi-benevolent deities were replaced, in the more civilised regions, by spirits and demons of malevolent, mischievous nature. Belief in these persists long. As recently as 1865, it seems certain, that it was rather the guides' fear of the demons and *geister* of the Matterhorn, than inability to climb it, which prevented its conquest for so long.

The horror and disgust with regard to mountains which for a time, about one hundred and fifty years ago, was so prominent a feature in contemporary literature, was the outcome of the almost total ignorance of the poets and writers of the flat lands of England, France, and Central Europe on the subject. Nor can

[1] Kasbek was a native chief in modern times.

we, considering the want of travel facilities in those days, so very much blame them.[1]

The pilgrims undoubtedly benefited very much in health from their ascents into the keener, purer air of the great mountains. Good spirits banished the bad, High spirits took the place of low. For many modern medical materialists it would appear that the microbe has taken the place of the goblins dreaded of old. In the old folk-tales, or "fairy stories," far more "scientific" —that means of knowledge—than much of the so-called science of the modern pseudo-scientific quack, the evil spirit had no power whatever over the really good. No more have the microbes over the really healthy. We are all prone to err, however, and require the help of the beneficent fairies of the high peaks.

After a period in the heights we feel, as Mr. C. E. Mathews has put it, renewed in health and youth, cleansed from the mud and debris of the turbulent waters of life. In the mountains we seek conditions which shall be as different as possible from those prevailing in the "Cities of the Plain."

The origin of mountain snow-pass travel dates back to long before the beginning of history. These passes would be traversed for trade, migration, and war. Dr. Coolidge, in his book, *The Alps in Nature and History*, has expressed the opinion as regards many of the Alpine passes first "discovered" by early members of the Alpine Club, that these had been in use hundreds of years previously. Mr. Douglas Freshfield, in his great work on the *Exploration of the Caucasus*, has given a list of glacier pasess known to the natives at the end of last century. Well-known historic passes, from 18,000 to 20,000 feet high, are to be found in the Himalayas. Anyone who has studied the subject, must be disposed to agree with Dr. Coolidge.

The first recorded ascent of an Alpine snow-peak is given by Dr. Coolidge as that of the Roche Melon

[1] Thomas Gray was a praiseworthy exception.

(11,600 ft.), near Mont Cenis, in 1358. This was done apparently in fulfilment of a vow.

The first rock-peak given is that of the Mont Aiguille, near Grenoble, in 1492. This ascent was made by one Beaupré, by the order of Charles VIII of France. This was rather in the nature of engineering than real mountain-climbing, and could hardly be described as a sporting effort.

Far different is it with the climb of King Olaf Trygvasson, more than 500 years earlier, up the rock-peak of Hornelen, on the coast of Norway, at the entrance to the Nord Fjord. The climb is described in the *Heimskringla* (about A.D. 1000), Olaf Trygvasson's saga: "King Olaf was of all men told, of the most of prowess in Norway. How he went up the Smalserhorn [Hornelen] and made fast his shield to the topmost of the peak."

It appears that two of his "court-men" had wagered each other they could climb the peak. One soon turned back. The other, who had evidently not studied climbing technique, got himself stuck. Olaf was appealed to for help. He at once went up, rescued the man, climbed alone to the top, with complete disregard of pitons, crampons, ropes, guides, ladders, and iron chains, and returned in safety with his probably brave and athletic, but wholly incompetent "court-man."

Olaf left his shield on the top, just as some Alpine club pioneers 1,000 years later, left their axes on a first conquered peak, as a proof and a challenge.

An enterprising walk of another king, Peter III of Aragon, was that to the top of the Canigou, in or about 1275.

That King Olaf's climb is a fact, and not a legend, I certainly quite believe. He was a born mountaineer, as well as seaman, and had the quick brain, and the close correlation of hand, foot, and eye, necessary for real eminence in the climbing art. It is related of him in the Sagas that he walked round his longship on the

oars of the rowers, while she was in motion, throwing up and catching three short swords as he walked.

Switzerland is naturally the first country where we find the cult of mountain-climbing for its own sake beginning to develop and to be expressed in literature. There was quite an extensive development in this direction in the middle of the sixteenth century. Conrad Gesner and Simler are the best known of these early mountaineers. Wars, and the general misery caused by them, intervened, and the ideas of Scheuchzer (1702—1711), are a retrogression on those of his compatriots 150 years earlier.

In 1741 two Englishmen, Windham and Pococke, visited Chamonix and the Montanvert, and "The Englishman's Stone" is still to be seen above the Mer de Glace.

It is to De Saussure, however, that we must ascribe the origin and development of the new profession of mountain-guide. De Saussure was a native of Geneva, and a member of the British Royal Society. He made his first visit to Chamonix in 1768.

He offered large inducements to the hunters, crystal-gatherers, and porters of the village, for the discovery of a way to the summit of Mont Blanc. The first party to gain it was of two, Michel Balmat, with Paccard, the village doctor, in 1786. De Saussure was himself conducted to the summit, along with a small army of guides, in 1787.

The Ortler, in the Eastern Alps, fell in 1800.

When the great war closed by the final defeat of Napoleon in 1815, travel on the Continent, and mountain exploration generally, became more possible, but for forty years proceeded very slowly. Its development during the last forty years has been on an enormously enlarged scale, and the literature of the subject has increased in even greater proportion. When the devastating effect of the colossal world struggle, now happily closed, shall have somewhat passed away there will no doubt be a still further development.

The first club for the climbing and exploration of mountains was founded in London in 1857, under the title of the Alpine Club. The Swiss and Italian clubs followed in 1863. In 1864 the Austrian was founded, and in 1869 the German appeared, these last two uniting later under the title of the German-Austrian Alpine Club. The French followed in 1874. The conquest of the last and most difficult of the great peaks of the Alps, La Meije, in Dauphiné in 1877, by M. Boileau de Castelnau, with the Dauphiné guides, the Gaspards, *père et fils*, after the mountain had been besieged for years by the best Alpine explorers of Europe, aided by the leading Swiss and Savoyard guides, was a splendid opening and encouragement for the new club.

Since the last-mentioned date the cult of mountain-climbing has become world-wide. There is not a country, hardly a district, or even city, within reach of mountains, which has not a special club of its own. The followers of the Alpine Club may now be numbered by hundreds, and the members of these clubs by the hundred thousand. I can here but mention a few of these clubs: The Alpine, and the Crimean-Caucasian clubs of Russia, the Norwegian, Swedish, Dutch, Belgian, and Spanish; the newly founded Alpine Club of Japan; the Scottish Mountaineering Club, founded as long ago as 1889; the numerous clubs of Canada and of the United States; the New Zealand Club; the Mountain Club of South Africa.

Besides these national clubs, there are very many local clubs. For some of these a very high standard of mountaineering ability is required. In Britain alone there are no fewer than twenty clubs concerned in mountaineering and climbing.

Last, but not least, this century has seen the founding of two exclusively feminine mountaineering clubs; the Ladies' Alpine Club, in London in 1907, and the Ladies' Scottish Climbing Club in Edinburgh in 1908.

Perhaps one of the most important effects these

clubs are having, and are likely to have, is the drawing together by mutual interests and sympathies in a common object, of widely sundered peoples.[1]

Guideless Climbing

I have not devoted a chapter to this, as in effect guideless climbing does not exist, at any rate not for long. The party which starts for the high snows, without being under the direction of one or two members, be they professional or amateur, who have some knowledge of guiding, is exceedingly likely to illustrate the parable of the "the blind leading the blind."

By guideless, however, is usually understood, without the assistance of professional guides.

At a comparatively early stage of its existence the Alpine Club was induced, perhaps by the occurrence of some accidents, perhaps by the publication of a book on guideless climbing, perhaps by a "middle-aged feeling" on the part of some of its then leading members, to put a ban upon guideless climbing. The ban was afterwards explained as a modified one, but undoubtedly the feeling against guideless climbing, persisted for quite a long time.

I cannot help thinking that those members of the Alpine Club responsible for this attitude, however high and admirable might have been their motives, displayed a great lack both of wisdom and foresight.

Guideless climbing was an inevitable development of the sport; by banning or ignoring it they merely took up the proverbially futile and foolish attitude of Mrs. Partington and her mop.

What was wanted was not a condemnation of what, after all, was a perfectly natural development, but a guiding and controlling of it. Had they considered the sea analogy, this would have kept them right. As

[1] As Robert Louis Stevenson says in *An Inland Voyage*, "What religion, after all, unites people so closely as common sport?"

yachtsmen, would they have banned the men who preferred to learn how to steer and sail their own yachts ? After all, the numbers of such " Corinthians " [1] will always be too limited.

The official feeling, at any rate, being thus against amateur climbers who preferred to do their own steering, had the unfortunate effect of forcing some of the best and most enterprising of British mountaineers to keep their doings semi-secret, or even entirely unknown. It is only in the last few years that we have been made acquainted, through the researches of Captain J. P. Farrar, with the fine guideless climbing done in the 60's of last century, by the Messrs. Parker, and in the 70's by Mr. J. A. Stogdon and others.

Even as early as 1856 Mont Blanc had been ascended by a party of amateurs, and by a partially new route.[2]

It was perhaps the successful ascent, only the fourth, of that extremely difficult mountain, La Meije in Dauphiné, in 1879, by the Messrs. Pilkington and Mr. F. Gardiner, which most largely contributed to the breaking down of the British prejudice against guideless climbing. Messrs. Pilkington and Hulton also ascended the Disgrazia " By a new Route and without Guides " a few years later.

In the 90's the brilliant exploits of Messrs. Mummery, Collie, Hastings, and Slingsby, mainly abroad, and of Collier, Solly, Haskett Smith, and Jones, mainly at home, showed that British enterprise was neither middle-aged nor decadent.

Most of these climbers showed, by their subsequent exploring successes on new mountains, that they were, both as mountaineers and climbers, not merely the equals, but much the superiors, of the best Swiss guides. In the Alps, also, another quartet, Messrs. Bradby, Wicks, Wills, and Wilson, proved that the reputedly hardest and most dangerous climbs in Europe

[1] " Corinthian ! a lad of mettle, a good boy " (*1 Henry IV.*).
[2] *Where there's a Will there's a Way* (Hudson and Kennedy).

were well within the powers of an experienced, united party of amateurs. Most of the prejudice and arguments against guideless climbing, which belonged to a century and conditions no longer existing, have now passed away.

CHAPTER II

EQUIPMENT

MOUNTAINEERING used to be considered a rich man's sport. So it is, no doubt, if one goes to the Alps, engages a couple of guides for two months, and puts up at the most expensive hotels. The actual equipment, however, is perhaps less costly than that required for any other outdoor sport. For this country in summer only a pair of nailed boots and a rope are required. In winter climbing at home, or for Alpine work, an ice-axe must be added. The clothing equipment is precisely similar to what any sensible person would wear on a walking tour, with the addition of special light garments for bad weather. Mountaineering is the art of ascending and descending mountains. This is done, even when the angle may approach eighty degrees, mainly by means of the feet. Mountaineering is walking *in excelsis*; therefore, the most important articles of equipment are—

BOOTS

Two serious errors are still too often made in the design of the climbing-boot. It is far too heavy, and it has projecting welts. In my opinion, the boots, besides being moderate in weight, ought not to have soles which project at all beyond the edges of the feet which are contained in them. Here I am going directly contrary to what has been laid down by the authorities in the past. I feel bound to give my reasons. If we look at the foot of a climbing animal, chamois, bouquetin, or klipspringer—the familiar goat will do—

we see that its hoofs are small, narrow, and sharp-edged. It does not wear the wide welts patronised by the elk or reindeer. The sole advantage possessed by the wide-welted boot is the greater bearing surface it presents for walking on soft or crusted snow, and this advantage is counterbalanced by the difficulty of withdrawal, and by the projecting edges catching in long grass, heather, or snow. The wide welts of the elk or moose, and of the reindeer, *fold up* on withdrawal from snow or bog. On rocks which are at all "difficult," [1] the smaller the boots the greater is the choice of footholds. It may often be observed that ladies and children may be more at ease on steep rocks with small footholds than the big, powerful man with his heavy and clumsy Alpine boots. It is mechanically obvious that if the holding edge of the boot is outside the edge of the foot, a very greatly increased strain must be put upon the foot, ankle, and leg muscles in order to retain the grip on small holds. In practice this strain and difficulty is still further increased by the fact that, though when new the soles of wide-welted boots may be flat, after having been wet and used for traversing, the edges invariably turn up to some extent. On steep grass, and on ice, the wide welt is also at a great disadvantage, and on the latter, of course, the labour of making the steps is proportionate to the size of the boots to be placed in them. It has been stated that very heavy boots, with projecting welts, are necessary in order to protect the feet from injury by rocks and scree. This is a fallacy, however. Far more important is the correct placing of the feet, and this is naturally greatly facilitated by the wearing of boots of moderate weight, without the clumsy, projecting welt. An argument of some force in favour of wide welts is that thereby the boot is prevented from twisting over sideways by use. This twisting over, however, will not happen if the boots have broad, low heels.

[1] See p. 50.

As regards weight, it is often not realised what a handicap heavy footgear is. A calculation shows that, given a difference of two pounds between the boots of two climbers, A and B, making the ascent of Nevis from Fort William, the heavier shod drags off the ground more than nine tons more than the lighter. The distance is seven miles, and the height more than 4,400 feet. In the case of Mont Blanc from Chamonix, the difference will come to nearly twenty-six tons.

Climbing-boots should, therefore, be moderate in weight, with welts the same width as the foot. The soles should be hard and stiff, the uppers rather thin and soft. If they are strong enough to last a couple of seasons' hard use, it is as much as one can reasonably expect. After that they will want re-nailing, and that means re-soling. Look with suspicion upon the climber who says he wears the same pair of boots without re-soling for three or four years. It will probably be found that his climbing is not of much account, or he is wearing boots which have badly worn and blunted nails, with worn-out and nail-sick soles, a worse climbing crime, if he proposes to join your party, than if he were to wander up the Weisshorn alone. There is no use asking for "waterproof" boots; you will not get them. I have yet to learn that a waterproof boot, except one made of rubber, exists. Partial waterproofing is best done by the wearer giving the boots dressings with some thick oil; collan is very good, so is odourless castor. Vaseline melted and rubbed in while the boot is warm is excellent. All oils and greases work out in time and must be renewed, but there is no use over-oiling. Animal fats have an objectionable smell, and their use is to be avoided, as they decompose readily, and rot the leather and stitching.

It is a very good system, on a long climbing holiday, to use two pairs of boots. This tends both to ease the feet and to make both pairs of boots last longer. Light lasts for the boots not in use, are well worth taking; these conduce to the welfare of both feet and boots.

New boots should never be taken out for the first time on a long, hard expedition. These should first be worn on a short, easy walk, preferably a wet one, in order to let them get the set of the feet. After this, they should be slowly and carefully dried, re-oiled and again worn a short time. Hurried drying near a fire is death to boots. I have seen a new pair drop to pieces on a climb through such maltreatment at an hotel.

Climbing-boots should not be high in the ankle, and a great improvement is having the tops finished off by a strip of felt about one inch deep. This allows of closer fitting round the ankle without risk of chafing. The tongue should be sewn right up, and the tab should be outside, and very strong. The best system of fastening, in my opinion, is half by lacing and half by hooks. The boots are then much easier to deal with, by cold fingers, in the dark, or when covered with ice and snow. All three of these conditions may occur at the same time. The objection that the hooks cut the puttees may be met by not wearing puttees, or by buying new ones when they are cut. Good strong laces of woven material are, in my opinion, preferable to those made of leather. The latter seem generally, to be made of refuse hide, and are very variable in quality. They also come untied much more readily. This may occasionally furnish a convenient excuse for stopping on a long, hot grind up an easy slope, but is not an advantage at an awkward place on a steep rock-face.

Kletterschuhe, Scarpetti, Espadrilles, Alpargatas

On the limestone rocks of the Dolomites, and also in the Pyrenees, nailed boots cannot be used owing to the hardness and slipperiness of the rocks. Nails are never safe on limestone, or in fact on any hard rocks of a slabby nature, which are also very steep and holdless. Kletterschuhe or Scarpetti, are soft felt or rope-soled canvas boots, not shoes, as often mistranslated. Those

with felt soles are the best. On very difficult, pure rock climbs, whether at home or abroad, they are of great advantage, and are also, of course, extremely light and comfortable. On ice, snow, or very wet rocks they are not at all safe.

Rubber Shoes

These have often been employed in climbing of a difficult nature, both at home and abroad. They are delightful to climb in on short, dry rock-climbs. For real mountaineering they are rarely worth their weight in the sack. Wet, of course, renders them far from safe. For any special bit of difficult rock met with in a mountain ascent, the boots may be removed, and the difficulty overcome on stocking soles. The only climbing surface better than this is furnished by the naked skin. It should be noted, as will be illustrated in the chapter on British Rock-climbing, that if socks are worn below the stockings, they must first be removed, and the stockings replaced. Double foot-coverings are very dangerous to climb in on account of the slipping between the two surfaces.

Nails

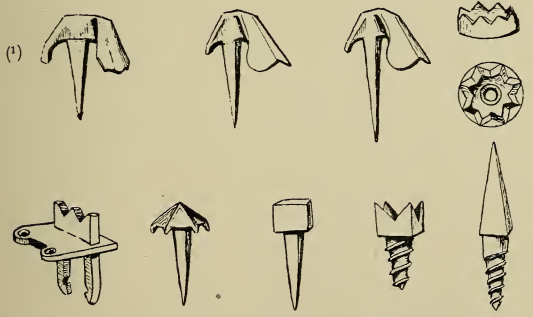
As boots are the most essential part of the climbers' equipment, so the nailing of the boots is the matter of supreme importance with regard to them.

The best system of nailing is by no means settled; new designs of nails and their arrangement are constantly being tried. The two best-known systems may be called the "continuous" and "separate" Swiss or "fly-wing" nail systems.

For ordinary hill walking, or even for fairly difficult rock climbing, the ordinary soft iron square British tackets are quite efficient. These grip, except upon the smallest edge-holds, rather better than the Swiss nails, and are of course lighter. They must be inserted close to the edge of the sole $\frac{1}{4}$ or $\frac{1}{3}$ of an inch apart.

They may be placed in threes, in rows, or irregularly in the centre; the pattern seems immaterial so long as too large vacant spaces are not left. Their great disadvantage is their liability to get kicked out. The boots must be gone over, and lost nails replaced after every climb. (Fig. 1.)

On the Swiss "continuous" system the fly-wing nails are inserted with the wings overlapping, right round the edges of the boot-soles and heels, including the front edges of the latter. Properly driven in, and in suitable hard leather, non-"waterproof" soles, these nails will not come out, but remain firm till worn out. (Fig. 2.) The centre of the sole can be filled in with smaller nails with irregular roundish heads (Fig. 3), or with soft iron square tackets, disposed in groups, rows, or irregularly. A modification of some advantage, is to have spaced nails of somewhat larger size in the heels.



The "spaced" Swiss nails have long shafts which can be driven obliquely through the edges of the soles, and clamped round. This enables them to stay in when isolated. An advantage of these nails is that,

(1) This is a bad form.

as fewer are required, some saving of weight is effected. They also give a somewhat better grip on grass, snow, rock, or ice, when somewhat worn, than do the continuous, and they are nowadays rather more popular. One disadvantage they have, is that their employment necessitates the wearing of somewhat wider welted boots than may be worn with the continuous nails. Another is, that though a lost nail may be replaced if continuous, a spaced nail generally brings a piece of the boot-sole with it. There is also a temptation, with this system of nailing, to defer the renailing of a boot too long, as this involves the resoling of the boots in most cases. (Fig. 4.)

Besides these more usual nailing systems, there are some where "built-up" nails—that is, nails consisting of more than one piece, are used. Two of these may be mentioned, the "Tricouni" and the "UHU." Opinions seem to vary greatly as regards the advantages of the Tricouni. Some mountaineers are in favour of them, but the majority of British climbers seem to consider that their disadvantages considerably outweigh any good points they may possess. I have no practical experience of them myself. Those boots nailed with them which I have examined, appear to have the chief defect of the wide welt boot in an inverse sense; the wide-welted boot has the holding edge outside the edge of the foot, the Tricouni nailed boots I have seen have had this holding edge inside the foot-edge. Both these systems tend towards insecurity, but the strain is much less with the Tricouni. (Fig. 5.)

The UHU was for a time rather popular with some continental climbers. It appears to me to be exceedingly clumsy and far too large.

"Star" nails are sometimes used for the centres of the soles and heel. These are circular discs of steel with serrated edges. They are secured by means of a screw which passes through a hole in their centre. In my opinion these nails are bad, as they are only safe

when quite new. As they are made of hard steel and the teeth are small, these soon get blunted, and slip on smooth, hard rocks. Even worse, after having been worn a short time, the discs become loose, and revolve freely on their screws. The screws may be tightened, but the remedy is only very temporary. (Fig. 6.)

"Ice-screws." These are square screws with four sharp points. In an emergency they may be occasionally of service. If they are to be used during an expedition, it is better to bore holes for their reception previously, packing the holes with paper, or, better, string, until required to insert the screws. If the screws are afterwards taken out the holes should be carefully repacked again. Ice-screws are none too good for the boots. They are, however, much less harmful than Mummery spikes. (Fig. 7.)

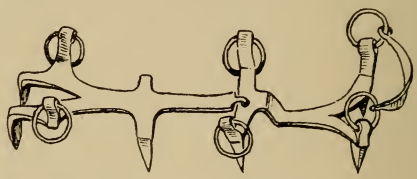
"Mummery Spikes." These are now very seldom employed. They spell utter ruination to the boot; in fact, their screws would go completely through the soles of a properly built mountaineering boot. One or two inserted in the heel, before the descent of not very steep ice-slopes, may occasionally be of some service, but for regular ice work they have been completely superseded by crampons. (Fig. 8.)

Crampons

This consists of a metal framework, which ought to be of steel, but frequently is not. It is hinged under the instep, furnished with eight or ten spikes round the edges, and clamps on to the boot-sole. We might perhaps anglicise the name to "clampons." We cannot call them climbing-irons, as that refers to the instrument employed in ascending trees and telegraph-poles.

The crampons are secured by a strap, preferably of hemp, which passes through rings attached to the framework, is crossed over the front of the foot, and over the instep, and firmly binds the steel framework

to the boots. Many of the crampons sold in Switzerland are useless and dangerous for climbing. The worst type is the single-piece four-spike crampon for fixing under the instep. This is only of service on ice or hard snow of very easy angle. The usual six-spike hinged crampon is not much better, and when made of soft welded iron, as it often is, will be tolerably sure to break if real hard work is required of it. Good crampons should be made of just two or three pieces of solid mild steel. They should not be welded anywhere, and the spikes should not be riveted in. The spikes ought not to be fewer than eight or ten, should be



CRAMPON.

sharp, not too thick, and not less than one and a half inches long. The main point to watch about a crampon, is to see that the spikes are, in number and position, sufficient to prevent the boot-edges from touching the ice except at really steep angles, when of course steps must then be cut with the axe. As with boots, the lighter the crampons consistent with strength the better. Very good crampons can be bought in Switzerland to weigh not more than about two to two and a half pounds. Naturally a tall, heavy man requires strong, heavy crampons, and it is a great advantage to have the crampons fitted to the boots by the maker of the former. Though the action in use is so different as regards skates and crampons, badly fitting crampons are quite as objectionable to the climber, as badly

fitting skates to the skater. Formerly, many methods, mostly clumsy and bad, were employed in making temporary connections between boots and skates. Nowadays, everyone with any pretensions to be a skater at all, uses special boots to which the skate-blades are permanently screwed, thus doing away with the weighty, weak, steel frame of the patent skate, and the heavy and clumsy frame and cold-inducing straps of the wooden-bodied skate. It seems to me that this method is the ideal for crampons also, if these are to be worn on the whole climb, whether ice or rock, as seems often the case in recent years. No one as yet, however, appears to have brought out a special crampon boot to which spikes are permanently attached. The whole question of the pros and cons of crampons in general mountaineering will be fully discussed in the chapter on "How to use the Ice-axe, Rope, and Crampons." Crampons are best carried, when not in use, in a special tin folding case to be obtained from the Swiss makers of crampons.

The Ice-axe

The Ice-axe is a two-purpose, or compromise instrument; therefore it cannot be made perfect for both. In its modern form it is the result of gradual evolution during a long series of years. The process of this evolution can be easily followed in the photographs and drawings of ice-axes in the hands of guides and climbers, in the Alpine Journals and books of climbing adventure. In the earlier of these, it was generally only the guides who carried axes; the amateurs were content with the more modest alpenstock, and many Alpine "Peaks, Passes, and Glaciers" were conquered in this fashion.

The ice-axe is evolved from the original alpenstock or baton, a long ironshod pole employed by the hunters

of alpine game, not only in the Alps but in the Caucasus and elsewhere.

I have seen a "Tur"[1] hunter's pole in the Caucasus Mountains, furnished with the very efficient spike formed by an old Russian bayonet.

For work in ice-falls and on the steeper slopes, the baton was sometimes supplemented by a short axe carried in the belt.[2] This no doubt was occasionally lost. Some innovator then hit upon the idea of fixing the hatchet to the top of the baton. Thus was formed a kind of halberd. Ice-axes of this description, some two metres in length, are still shown in Chamonix. The halberd was gradually reduced in weight and length, the hatchet blade was turned adzewise, and the back of the hatchet prolonged out to a pick, for the purpose of digging into the ice. The pick then developed in weight and length, and became the real working part of the axe. I think the limit has now been reached, in the best modern axes, to this process of shaft-shortening. Indeed, in my opinion, the extra short pattern of axe, evolved by a well-known amateur, has only succeeded in becoming quite useless as an alpenstock, while of very small service as a hatchet.

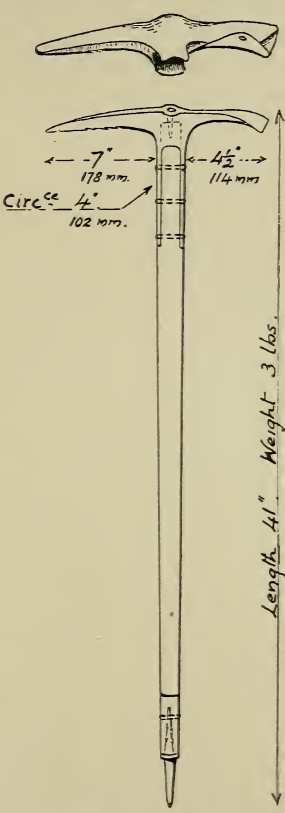
The long shaft has many advantages, for glissading, for traversing, for ascent and descent at moderate angles, and for cutting downhill, and we cannot reduce the shaft below a certain length without seriously impairing the total value of our combination tool.

The dimensions of the modern ice-axe here illustrated will be found of good all-round utility for the average sized climber, say 1·75 metres (5 ft. 9 in.) and say 70 kilos (about eleven stones).

The shaft should be of tough, even-grained, well-seasoned ash, or hickory, and is preferably hewn, not sawn, from the log. The grain should not "run out" diagonally. In cross-section it ought to be well oval near the head, and the oval should persist, though less flat, to where it enters the spike-ferrule.

[1] *Capra Caucasica.* [2] See cover of *Alpine Club Journal.*

It will probably be found better to choose an axe to suit from a stock than to order one specially made from dimensions. If the axe is meant for step-cutting and hard use generally, the shaft should be strong enough to bear the wielder's whole weight kneeling on its centre, when the axe is laid with only the head and metal spike resting on two chairs. If the seller will not allow this test, refuse the axe. The head should not be made of iron or welded in any way. It should consist of a single piece of the best steel. In temper it should not be too hard; if soft enough to be nicked by an ordinary pocket-knife it will be about right. Teeth are sometimes cut on the underside of the pick. These at any rate do no harm, and I have known a time when they proved of service. A roughened under-surface to the adze blade, though as one authority sarcastically observes, "Perhaps useful to strike matches on," is a nuisance in sticky snow



ICE-AXE AND HOOD.

conditions. A high polish renders the axe easier to keep from rusting; perhaps a "rustless" surface would be most convenient

The head is secured to the shaft by a long screw. This passes through the head and runs several inches up the shaft. In addition, steel lugs run in slight recesses cut in the shaft sides. The lugs are connected with each other by three countersunk copper rivets passing through the shaft. The length of these steel lugs is important; if too short, the axe-head is apt to be broken off when the weapon is wielded by powerful arms. This was a weak point with the old axes. The lugs should not be less than seven inches long. The spike should be of the same material as the head. It is best made of one piece, with a smoothly sloping shoulder, and with a hexagonal or octagonal point, or like the pick. Both head and spike ought to be covered, when not in use, by leather hoods.

No bulb, leather collar, rubber tube, or anything whatever should mar the symmetry of the shaft. The first two excrescences prevent the proper exercise of one of the axe-shaft's functions, that of acting as a probe for testing the snow's condition near cornices and crevasses, and on bridges. Also the free handling of the axe in cutting steps. The last is simply a piece of futility for a *working* axe. In reality, it is desirable that a certain amount of slipperiness should be possessed by an axe for real use, otherwise it is difficult to make the fine adjustments necessary when cutting from a fixed position, such as an ice-step.

Ropes

It would be quite impossible to carry a rope which would never break under any conditions. We therefore should be careful to have one of convenient diameter and length, of strength sufficient to support any probable strain or shock, and well tested and guaranteed by a responsible maker.

Numerous trials and testings of climbing-ropes have been carried out from time to time, both in this country and abroad, from 1864 onwards. In these it has always appeared that the best and most trustworthy rope is the English Alpine Club rope. This is made of Manila hemp. It is distinguished by having a red thread in each of its three strands. Latterly another rope, also a London-made rope, has proved itself of great excellence under engineering tests. This rope is made of flax.

After considerable practical experience, under very varied climbing conditions, of both these best kinds of rope, I may here summarise my conclusions.

(1) When both ropes are new, the flax rope is slightly lighter, is softer and more pleasant to handle.

(2) It does not stand hard wear so well: i.e. it rubs and looks old sooner.

(3) When well stretched and used a good deal in wet snow, it does not seem to recover its resiliency so well as the hemp rope.

(4) The three strands of which the flax rope is twisted, probably from their smoother fibre, do not seem to cling so well together as the three strands of the Manila. The flax rope becomes untwisted more readily. This may lead to a stretching of one strand, and thus to a weakening of the rope.

For real hard work I prefer the Manila rope; but, as both ropes possess a quite adequate margin of strength when new, and climbing-ropes should not be used when at all worn or old, there is little to choose between the two kinds.

Both these English-made ropes are laid ropes—that is, the strands of which they are composed are twisted or "layed," and not plaited. It should be noted that the Manila forms a right-hand helix—that is, it is laid from left to right; the flax is the reverse. It is, therefore, inadvisable to mix the ropes.

A number of foreign-made climbing-ropes are formed of plaited, not twisted strands. These ropes are supple,

pleasant to handle, and do not kink. Plaiting is, however, a wrong system of construction for a climbing-rope. These plaited ropes compare very badly with laid ropes under strains, especially under sudden strains. The strands then cut each other and the rope bursts. The main safeguard of a climbing-rope is its resiliency, or "life," as a sailor would say. A rope is worn out or "dead" if its resiliency has been lost. The plaited rope's chief fault, apart from poor material, is low resiliency.

Some climbers kill their new ropes for what they consider the crime of kinking, by overstretching them; such as tying them tightly between two trees, or posts, and leaving them out all night in the rain. Stretching a new rope should always be done with moderation, and by man-power, not with the enormous force of water-swelled fibres.

In practice I have never known a sound English Alpine rope to break with the weight of a man. On the only occasion on which I used a plaited rope, the ascent of the South Aiguille D'Arves in Dauphiné, one of the party fell off the bulge of the "Mauvais Pas" (there was no fixed rope and no shoulder was used). Though he only slipped down a few feet, and I was easily able to sustain the jerk, it nevertheless burst his Austrian woven rope about half-way through.

The occurrence of a number of cases in which these woven ropes, Austrian, Bavarian, or Swiss, had failed to stop comparatively slight falls, led the Swiss Alpine Club, some years ago, to make extensive tests of different kinds of ropes. Some interesting points were brought out. The marked inferiority of the plaited ropes, even when thicker and heavier, in sustaining sudden strains, was, as might be expected, fully demonstrated. It had been suggested that a frozen rope might be more liable to break than an unfrozen, but the trials at Zurich did not confirm this.

Both British ropes weigh roughly one pound per 20 feet, and measure 11 or 12 millimetres in diameter,

about 1¼in. in circumference. "Alpine Line," half the weight of this, may be carried as a reserve. It is useful for hauling up baggage, as a safety cord for securing the last man on the descent, and is quite strong enough to support the weight of two men at once, if no jerk occurs.

Silk ropes have occasionally been used by climbing parties. The advantages claimed for them are lightness and strength in excess of the ordinary rope. There is, however, silk, and silk. Some of these silk ropes in tests made on the Continent, have come out surprisingly badly ; probably owing to the prohibitive cost of silk of first-class quality, these had been made of low-grade windings.

The few silk ropes which I have handled and used, have seemed unpleasantly thin and hard. They certainly appear to last well. Their price, however, puts them out of the reach of the average mountaineer.

Cotton has been suggested as a material for climbing-ropes. I am not aware that it has ever been used for these. The thick, fixed ropes placed by the guides to lighten their labour and shorten the journey, on certain Alpine peaks, are often made of cotton, probably for the sake of cheapness.

The solitary fixed rope which remained on the Meije in 1919, at the Brêche Zsigmondy, was of cotton. It had been there from before the war at least, and was obviously *absolument pourrie*.

Cotton absorbs water too easily, becomes too heavy and sodden, and is too soft and easily rubbed for a carried rope.

A suggestion was made to me by an engineering friend to try a rope with a flexible steel wire centre. Apart from weight, however, this would do away with the laid rope's chief advantage, resiliency.

A point often totally ignored by engineer testers of ropes, who use a weight, a stone, or a bag of sand, to represent the body of the climber, is that a man's body has no resemblance whatever to any of these

substances. A jerk which would leave the molecular structure of a lump of granite quite unmoved would crush a man's ribs flat, or fatally disarrange his vitals. The moral of this is, that, given a reasonable margin of strength, there is no use carrying a rope of weight in excess of this.

Clothing

Clothing should be all wool, both under and over. In former times far too much heavy clothing used to be worn by Alpine climbers. Now the tendency among rock-climbers, at home at any rate, is to wear too little. A happy medium is the best, but it is generally better to wear a moderate amount of clothing, and supplement it by carrying light extras in the shape of Shetlands, than to overheat oneself by too thick and heavy garments on the lower, hotter slopes. Coats of gaberdine, dexter, or similar closely woven and partially waterproof material, are often worn nowadays. They are light, wind-resisting, and have the conspicuous merit of not accumulating snow, to afterwards melt and soak in, as rough woollen coats do. Coats made of rough loose wool, such as Harris tweed or Irish frieze, are quite useless for the mountaineer. These tear easily on rocks, collect snow in large quantities, and are not much more comfortable in a cold wind than a fishing net would be. Good sound tweed, of close texture and medium weight, seems the best all round. The armholes of the coat ought to be made specially loose, but the Norfolk jacket style has no advantages over an ordinary loose high-buttoning coat, and a belt is simply a nuisance to a climber. The coat, waistcoat, and the waistband of the knickers should be lined with the thinnest possible flannel. Some climbers have great faith in a wool cholera-belt, but if all wool undergarments are worn, and the tailor is not permitted to line the knickers with cotten or linen, the cholera-belt should not be required. Cotton is only for cloth-

ing for hard, sweaty work, when it can be worn in one thickness. Cotton fibres absorb, wool fibres do not, and this explains the reason of the horrible clammy feeling of cold, damp cotton.

Knickerbockers are almost always worn when climbing, by amateurs. A few of these, and many of the older guides, wear ordinary long trousers. The amateur usually in this case winds puttees round his legs, the guide puts on a pair of gaiters when soft snow is to be traversed. The riding breeches style of knickerbocker is to be condemned, and the boxcloth continuations are restrictive and unnecessary. A simple cloth strap, with a plain, not toothed, buckle is the best style of fastening below the knee, or a lacing may be used. The traditional conventional "Swiss," really Tirolese guide, is always represented as clad in gaily ornamented shorts, with a considerable expanse of bare thigh and leg. Like the kilts of the Scottish Highlander, shorts are ideal for hill-walking. Both styles of garments are utterly unsuitable for real climbing. Knickers made of velveteen, corduroy, or canvas materials, are frequently worn by foreign, and sometimes by British, mountaineers. These are thick, heavy, and stiff, and, when wet, take a long time to dry. For the ordinary standard Alpine ascents, such as the Matterhorn, Weisshorn, Rothhorn, Dent Blanche, where the rock-climbing, in good condition, is from a British standard easy, flannel makes a delightfully light and comfortable style of garments. I have worn flannel undamaged on many long Alpine traverses, but I do not consider it thick enough, or strong enough, for the colder, rougher work on British crags.

The knickers may be supported either by braces, or by belt or buckling. Those climbers who prefer the utmost freedom of every muscle, which is the writer's position, will use braces. The other method also causes the shirt to ruck up in a disagreeable manner on long, hard rock-climbs.

The shirt should be of good medium-weight flannel,

or of silk ; detachable collars of flannel, or silk, are most convenient. The undershirt and pants are best in combination form. It is better to wear two thin undergarments than to carry thick, heavy outer clothing. As still air is the best heat insulator, the double under garments keep one cooler in heat, and warmer in cold, than a greater weight of material in single form.

Pockets should be numerous and roomy. I usually have about twenty. All should be made to button. Two large pockets inside the skirt, usually called hare, or poacher's pockets, are often useful. The pockets should be of strong linen material, and the knicker pockets should also be covered on the side next the body with the lightest flannel material. Mackintosh lining for the pockets, sometimes recommended, is a great mistake. It causes the pockets to rather collect and hold moisture, and soon perishes. Anything it is specially desired to keep dry should be wrapped in oilskin or gold-beater's skin, and fastened with a rubber band.

Do not have the coat treated with an alum solution for the purpose of making it "waterproof." The process makes the garment heavy and stiff ; it does not make it waterproof. In any case, all waterproof close coverings, from hat to boots, are unsuited for the hard exercise of climbing.

Stockings, Socks, Puttees, Anklets, Gloves

Double stockings, or socks under stockings, should always be worn. In addition to being a much better cold or heat insulating method than a single pair of extra thick stockings, this arrangement almost entirely does away with blisters. To be most effective, the under sock should be closely fitting, and of thin, smooth, natural wool, or of silk. The stockings can be of ordinary make and weight. The main point is to

ensure that any rubbing which may take place occurs between the two wool surfaces.

Puttees are now very generally worn in the Alps, and have to a great extent ousted the gaiters formerly the rule. These bandages are justly not in much favour with home rock-climbers, and even for snow work a modified short puttee, coming up so far as just below the calf, is to be preferred. Puttees, unless very carefully put on, are apt to be either too tight or too loose. In the former case they tend to stop the circulation, and interfere with the action of the leg and ankle muscles; they tend to cause, not prevent frost-bite, and generally to interfere with the proper use of the feet and legs. If too slack—that is, slack enough to obviate these evil effects—then they will not stay up during a long climb. Puttees in fact, in my opinion, are quite unsuited to the European leg, with its generally well-developed calf muscles.

I observed some Engadine guides, in 1910, using the modified half puttees. They had evidently already found out the unsuitability, for climbing, of the full-length bandage. An imitation puttee made of knitted wool, really a kind of footless stocking, is now to be obtained. This gives the neat effect of the puttee, without its evil constrictive tendencies.

Anklets of knitted wool, of cloth, of canvas such as those used by shooters, can often be of service. Those made of knitted wool do not last long. The simplest, and one of the most effective methods of preventing twigs, small stones, or snow, from getting in at the top of the boots is to use an old sock with the foot cut off as an anklet. Boot-tops of felt also help.

Gloves. Though less important than boots, gloves suitable for various conditions should be used to cover and protect the hands. It is obvious that gloves add greatly to the safety of climbing. It is much easier to feel for holds with warm and comfortable fingers, than to fumble for them with half-frozen, cut, or scratched hands. For rocks in summer conditions, thin leather

or kid gloves may be used. Old dancing-gloves can prove of great service. These should, of course, not be too tight. For snow work of any difficulty, especially if on snow-covered rocks, two pairs of wool gloves must be taken. One pair may be provided with separate fingers, for use on fairly difficult rock. The other should be of the pod shape. These latter are to be kept in the pocket, and only donned on halts. By this means frost-bite is prevented, and the fingers kept at their fullest efficiency.

Ladies are sometimes warned against climbing, on account of the damage it is supposed to do to the hands. Abrasion of the skin is little likely to occur if gloves are used. At first there is a tendency to feel uncertain of the holds when wearing gloves, and, where any difficulty is met with, they can be removed till it is overcome. Practice will soon diminish the number of the "difficult" places where they have to be removed. In wet weather leather gloves are apt to be slippery on rocks. Wool gloves hold well under wet conditions on rocks, and give a splendid grip on hard snow. It is quite easy to cut ice-steps and do ordinary climbing, after some little practice, in the pod gloves. Waterproof rubber gloves have sometimes been used on snow-climbs. Loose rubber gloves, to put over dry wool gloves at a halt in bad weather, might prove serviceable.

Hat, Cap, Helmet, Scarf, Goggles, Mask

The best all-round hat for mountaineering is the soft felt hat called the Alpine. The brim should be wide; not only for the purpose of protecting the face from the powerful rays of the sun, but, even more important, the back of the neck as well.

The brim must not be too stiff, or the hat will blow off in a wind. On the other hand, it must not be too soft. If too soft, it blows into the eyes. In wet weather the top of the hat is pushed up and the brim turned down. Water is thus prevented from soaking

through to the head, or running down the neck. In crossing a snow-covered glacier on a blazing hot afternoon, a most effective brain protector is provided by means of a lump of snow carried in the pushed-in top of the Alpine hat. The hat may be secured, if desired, by a hat-guard; but this is rarely required, and is apt to be a nuisance on steep rocks.

Caps are often worn by British rock-climbers. Though too easily blown off, they do fairly well in dry weather. They soon get soaked in wet weather, and then permit the rain to run very freely down the neck. They are quite unsuitable for Alpine work.

Helmet. Every climber in bad or doubtful weather, or where there is the least chance of being benighted, should carry in his sack a woollen helmet. Those made of Shetland wool are the best. These are light, can easily go into the pocket, and give an enormous amount of heat for weight. Heavy leather or rubber helmets, or oilskin sou'westers, are quite unsuited for such work as mountaineering.

Scarf. This is also best of light fine Shetland wool. It may be six feet long and ten inches wide, and yet go into very small bulk and weigh only a few ounces. It can be worn anywhere, and in the form of a night-cap, helmet, comforter, extra jersey, waist-belt or cummerbund, and either under or over the clothes, and may also be made into the warmest of sleeping-socks for the feet.

Goggles. These are tinted spectacles used to cut off the actinic sun-rays and thus prevent injury to the eyes, while the mountaineer is crossing fields of snow. Too dark a tint is a mistake. It is better to use goggles which interfere as little as possible with the natural appearance of the surroundings. The tint called London Smoke is suitable. Goggles may be had at prices from one franc to one guinea. The simplest is really the best and most convenient. These are light and not easily broken, and two pairs should always be taken. One pair can be carried on the hat secured by

ordinary hooks. Another pair may be carried in the pocket in a small tin box. The rim of the goggles, where they touch the skin, should be lined with velvet, and the connecting strap over the nose is also best made of, or covered with, this material.

Masks used often to be worn as a protection to the face on glaciers. They were made of linen or cotton, with holes cut for the eyes. They give the wearer a most weird and sinister appearance, and are rarely seen nowadays.

Extra and Overall Garments

A cloak or coat of any kind is inadmissible for actual climbing. A light mackintosh cape, or zephyr oilskin, may be used to turn a shower on the way up to the hut. The *wettermantel* of *loden* cloth, so often observed on the Continent, is the badge of the "valley-pounder," not of the mountaineer. For British winter climbing however, where snow is so often mixed with rain, these garments are quite useful. They turn an enormous amount of wet, and the skirts are light and easily turned up under the rope. Loose capes are simply a nuisance, and may easily prove dangerous in climbing.

Soft, light, air-holding Shetland jerseys are by far the most valuable form of extra clothing. Two of them should be in the sack of every climber who starts for a long, hard, Alpine climb, with any possible chance of being benighted. They are, of course, worn under the coat.

Face Protection

Everyone knows the painful effects of the sun-rays reflected off water. When these rays, striking through the thin, clear atmosphere of glacier heights upon snow, are reflected on to unprotected skin, the effect may be of almost total destruction. In bad cases of glacier sunburn the face swells, great blisters form, which later burst and discharge great quantities of fluid.

The outer skin peels off, and the process of healing is long and painful. This result used to be combated by wearing masks,—a stuffy and cumbersome method,—or by rubbing the face with an emollient. Simple oils, vaseline, or lanoline, are not sufficient, but there is no doubt that soot or burnt cork, on a basis of grease, forms an efficient safeguard as long as it remains.

The cause of the death of the skin tissues, is through the chemical action of the ultra-violet rays, or actinic light, and it should be noted that mist does not stop these chemical rays. One can get badly burnt in crossing a freshly snowed glacier, even in a thick mist. A preparation which I have found to be an absolute specific is "Dr. Séchéhaye's Pomade." Since using this I have never had the slightest degree of burning. The sole disadvantage of the "Séchéhaye" is the somewhat bilious tint it imparts to the complexion. I would suggest, for the benefit of those who find this effect distressing, that they might add a small quantity of rouge to the pomade. I have seen the rouge-paint of the stage used by a party of Italian lady-climbers, but it is of too melting a nature, as even a Sherlock Holmes could not have failed to track them by means of "The Red Drops in the Snow." Most emollients are, like the rouge-paint, too easily melted. The Séchéhaye is of a much harder nature. To ensure its easy removal it is necessary to rub the face with a small quantity of oil or butter. When putting it on, special attention should be paid to the points of the nose and chin, the cheek bones, the under sides of the nostrils, and round the lips. It is sold in convenient-sized compressible tubes, and does not require to be thickly spread.

Rucksack

This is a square or oblong loose bag, with draw-string to close the mouth, and comes originally from the Tirol. It is a great improvement upon the stiff knapsack from which the early climbers suffered, and has

completely ousted it for mountaineering. The knapsack was galling to the back, restrictive to the shoulders, and carried the load far too high up, thereby interfering with balance. The rucksack, when properly shaped, packed, and worn, reduces the strain and disadvantage of a load to a minimum. If improperly arranged, most of its advantages are lost, and it approximates to the evil tendencies of the knapsack. It is surprising how often, both in this country and abroad, one sees this happen. The following points with regard to the rucksack and its proper use may be of service.

(1) No canes or holders should be fitted between the sack and the back.

Reason. One of the main points about the rucksack is that it fits closely to the back, and moves with the body, interfering little with the balance.

(2) It should be worn as low down as possible, right in the small of the back, to bring the weight, and therefore the centre of gravity, of the climber low.

(3) Heavy articles should be placed in the bottom of the sack, for the above reason.

(4) In order to make it fit closely, and thus prevent side-swing, and also for the wearer's comfort, soft articles should be packed where the sack is in contact with the wearer's back.

(5) Rucksacks ought never to be tightly packed; their size ought always to be ample for the bulk carried. Tight packing raises the centre of gravity, and causes the sack to roll on the back, thus spoiling the balance.

The chief fault, from a climber's point of view, with the ordinary rucksack, more especially the British-made sacks, is their excessive weight. They are usually of thick, strong canvas, and lined throughout with the usual alleged "waterproof" material. If this is torn out and thrown away, the sack will be lighter. British-made sacks certainly last well. I have a sack specially made to my order a quarter of a century ago. It has travelled many thousands of miles, by rail and steamer, by motor and diligence, by horse, mule, donkey, and

porter-back, as well as several thousand miles also on the carrier of a motor-cycle, a more severe trial than any, and is still quite serviceable; but I never carry it myself, as, though not large, it weighs several pounds. In my opinion, the climbing-sack ought to be as simple and light as possible. The one I now carry, of my own design, is an absolutely plain square bag of tough, light, semi-waterproof cloth, without any metal fastenings whatever. Anything it is specially desired to keep dry is placed in a separate jaconet, or oil-silk bag inside. I do not believe in a water-proof lining for a sack. When these do not speedily rot and perish themselves, they cause the rapid rotting of the sacks by preventing them from drying properly after being wet.

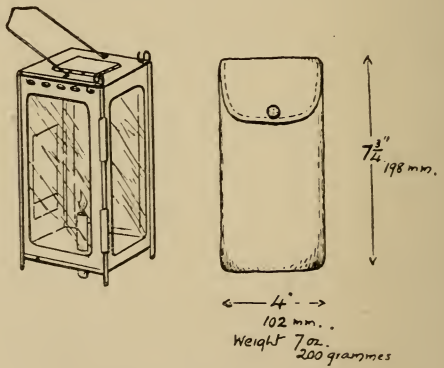
Pockets inside are a nuisance, and tend to interfere with the proper stowage of the weight. Outside pockets are best reserved for porters and low-level sacks. Foreign-made rucksacks are lighter and cheaper than British. They are, as a rule, of inferior quality. Rucksacks with narrow leather shoulder-straps should be avoided. Straps of broad webbing are much better, and are much less affected by rain.

It is not easy to pack a rucksack to find things readily. A system of small oil-silk or jaconet bags may be adopted. These may be of different colours, or marked outside with their contents, to assist the search for any special object. If the situation is convenient for such a proceeding, turning out the sack's contents and repacking will probably save time, and will be better for one's after comfort, and the balance of the rest of the load.

Lantern

The best Alpine lantern is the square folding Italian lantern called the "Excelsior Lux." Those made of tin, though rather heavier, are better and give less trouble than the aluminium,

The small three-cornered Swiss folding lanterns are not good. The insufficient air-space inside causes the candle to melt and waste rapidly, unless a very small candle is used, when the lantern becomes inefficient. The holes for the admission of air can be partly closed in a high wind; if dry, by pieces of stamp-paper or insulating tape; if wet, a handkerchief may be sacrificed to save the candle from wasting or blowing out. The hardest obtainable candles should be used. Ordinary wax candles last a very short time, and will give annoyance by dropping through the holder.

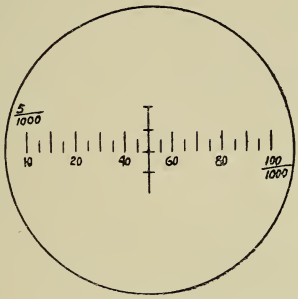


LANTERN—"EXCELSIOR LUX"

COOKERS

The most convenient and portable cooker for ordinary Alpine climbing, where only a small amount of cooking has to be done, is the nested aluminium stove, burning alcohol vaporised and mixed with air. It is provided with a wind-screen and stand, which fits inside the cooking-pot, and the lid can be inverted and used as a fry-pan. Owing to the screen, the stove will burn in almost any wind, and for this reason is more efficient

for out-doors cooking, and is of course much lighter than the cheaper and more powerful paraffin stove. The best of these is the Primus, the most powerful, economical stove for tent, hut, or small yacht cookery yet devised. The smallest form, the "Pocket," will heat up a tent, or a small yacht, in a few minutes. The cost of running is, of course, only a fraction of that of the alcohol stove. Its considerable weight is against it for Alpine work.



Calibrating Disc (see p. 239)

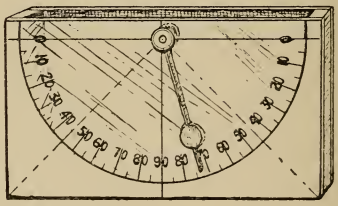
Aneroid

This, though the better makes are rather heavy, is a most useful item of general mountaineering equipment. For exploring work it is, of course, essential. It gives approximate results in many cases, where weather or lack of time prevent more accurate methods of measuring heights from being employed. On known mountains it may easily save a night out, perhaps life itself, used in conjunction with map and compass, by fixing in mist, storm, or darkness the exact position the party is in. On known heights the aneroid can be read with great accuracy, if, during the climb, it is checked against a map-height on the journey, and the variation from the triangulated height allowed for during the subsequent readings. On several mountains

of 14,000 feet, triangulated, but not ascended before, I have seen it give readings only differing from the triangulated heights by ten to fifty feet.

Clinometer

The circular form is useful for giving an approximate idea of comparative heights. For measuring snow slopes, the handiest and most easily read instrument is in the form of a flat, oblong piece of wood, four or five inches long, by two to two and a half inches broad.



Clinometer

In this a semi-circular recess is cut out, covered by a piece of clear celluloid. Inside the recess, a metal pointer swings by gravity, and indicates the angle of inclination on a card.

The fairest way to take the angle of a snow-slope would seem to be this. Place the ice-axe straight up and down the slope. Push the pick in till the shaft just touches the surface from head to spike. Now apply the clinometer to the middle of the shaft. If the slope is of ice, the axe must be laid sideways, and held in position. Of course if the slope is of any length, a number of measurements must be taken and an average made. A single measurement is very apt to bring out a much higher angle than the actual angle of the slope.

ANEROID.

COMPASS.
The "Magnapole" with protractor in lid.

Compass

This is a very necessary part of the equipment of the mountaineer. The prismatic form is the best, but it is often rather heavy. The prismatic has no advantage over a smaller, lighter, ordinary instrument as a guide in mist or darkness. The compass, in any case, should have a floating dial,[1] and be provided with luminous points, so that it can be read in the dark with a fair degree of accuracy. Some illustrations of the use of the compass will be given in Chapter XII.

Maps

All mountaineers will, of course, carry the best maps obtainable. These are naturally nearly always the Government maps of the various countries concerned. Some special climbing maps of certain districts in the European Alps have been issued by the various Alpine clubs, which are better than the government maps. Several extra-European climbing explorers' maps are distinctly in advance of anything the Governments concerned have hitherto attempted. The Swiss Federal map, on the scale of one in 50,000, (a mile to the inch, equals one in 63,000 nearly), is by far the finest mountain map in the world.

The French, Austrian, and Italian maps are considerably inferior. The largest scale general mountain map, is the latest Russian survey of the Central Caucasus. This was almost completed in 1914. It is on the scale of one verst to the inch, one in 42,000. Like most of the Alpine frontier maps, this is on the hâchure or sketch system, and is without contours. It, of course, does not possess the beauty and accuracy of the Swiss map. The Indian frontier maps are, as regards the delineation of the mountains, snow-fields, and glaciers, naturally considerably behind the Russian maps of the Caucasus.

[1] This bars the compass-clinometer, which necessitates a fixed dial.

The Ordnance Survey maps of the British Islands, on the one-inch scale—one in 63,000—are the best for hill-walking. The very large maps, six inches to the mile, about one in 10,500, are useful for the examination of special small rock areas. The scale is too large for them to be of general use. They often give information not to be obtained on the smaller scale maps.

Photographic Equipment

The camera is not an essential part of mountaineering equipment, but it is almost the exception to find a climbing party without at least one. This, for the sake of lightness and handiness, will be usually a small pocket camera of the " press-the-button " type.

For the purpose of obtaining climbing incidents, and topographic notes, these little cameras are invaluable ; for obtaining true pictures of mountains, they are almost useless. If, however, a size is carried just big enough to make a lantern slide without enlargement —6 × 6·5 centimetres is the smallest—then some part of the effect desired may be brought back on the screen.

Practically all the best views of snow-mountains have been, and still are, taken on whole-plate glass, but this involves a special train of porters to convey the weighty apparatus, and mountaineering in this case must be subordinated to photographic requirements. The expedition then becomes a photographic one, and not a mountaineering. As a keen photographer myself, I can sympathise with the photographer and his lost opportunities on a climbing trip, but also, as a leader, can understand the extra difficulties in the way of successful ascents involved by the weights and delays of stand-photography. Those who overcome them deserve all the more credit. For the average party, whether guided or not, the little snapshot camera, to which perhaps may be added a light stand, is all that the guide will put up with, or time afford. It has sometimes been recommended, that a stand should be

made of the ice-axe by drilling a hole through the adze, to which the camera can be attached by means of a screw. This is really useless, unless perhaps on an absolutely calm day, and in deep snow. Vibration is pretty sure to ruin a time exposure otherwise.

The stereoscopic camera gives pictures of actual angles and incidents of climbing very interesting when viewed through the proper instrument. Viewing the ordinary print through a reading glass, holding it at the same angle as that at which the lens took it, gives, with the better class of lenses, almost the same effect as the stereoscope.

Colour photography has hitherto not been much resorted to by mountaineers. Certainly splendid effects have been obtained in depicting the snows and rocks without it, but a very common defect in otherwise good snow-mountain scenes arises from the over-correction caused by the colour screen. This makes the sky far too dark. Colour photography gives here a much more natural effect.

For the violent contrasts, and powerfully actinic light of the high snows, the use of the colour screen is essential. This should, however, not be overdone; probably as regards Europe, four or five times will be enough.

It is difficult for the photographer, accustomed to ordinary conditions, to realise the enormous reduction in the time of exposure necessary on snow at great heights. Over-exposure is almost certain unless an exposure meter is carried and most carefully consulted. Even then a great deal of experience and judgment is necessary, as the distance factor is even more important than at sea-level.

Telephotography is exceedingly useful in pioneering exploratory work. It also gives much truer pictorial effects, in many cases, in views of familiar peaks. It requires specially clear atmospheric conditions, and is very sensitive to the effects of vibration.

The kinema panoramic views give by far the most

realistic idea of glacier heights. Some of these, with clouds in motion, are exceedingly beautiful and real. Sometimes, from ignorance, or sheer foolery, kinema pictures of mountains and of mountaineers, are utterly ruined by being put through the lantern at a preposterous speed. The apparatus is too heavy for the ordinary climbing party to handle.

I give here a number of references to articles written by mountain photographers. The study of these may prove useful for the climber who wishes to know the best instruments to take on the heights, and the best ways of dealing with and overcoming the special difficulties involved in photographic work on the high snows.

"Notes on Photography in the High Alps" (H. B. George, *Alpine Journal*, iv., p. 217), 1869.
La Fototopographia (P. Paganini), 1881.
"Photography in the High Alps" (W. F. Donkin, *A.J.*, xi., p. 63), 1882.
"Climbing with a Hand Camera" (W. Leaf, *A.J.*, xv., p. 472), 1891.
Mountaineering, chapter xv., "Photography" (C. T. Dent), 1892.
Hints on Snow Photography (Mrs. Main), 1895.
Alpine Photography (T. W. Wall), 1896.
"Photography in Winter and Summer in the Alps" (Captain Abney, *A.J.*, xvi., p. 37), 1893.
"Alpine Photography" (Captain Abney), 1898.
Photography in the High Alps (S. Spencer), 1899.
La Photographie des Montagnes (M. J. Vallot), 1899.
"Telephotography" (Charles Shea, *A.J.*, xx., p. 393), 1901.
"Guide de l'Alpiniste Photographe" (M. J. Vallot, *Manuel D'Alpinism*), 1904.
"Colour Photography for Mountaineers" (Dr. W. Inglis Clark, *A.J.*, xxvi., p. 1), 1913.

Smaller Articles and General Remarks

It is hardly necessary to enter into much detail with regard to these. What to take depends very much upon the personal tastes and objects of the climber. At the end of this volume is given several packing lists for consultation. These are for ordinary Alpine ascents, and can be added to or deducted from as found suitable.

Not a bad method of arriving at the minimum, the

best, if enough clothing and food is allowed for, is this. Think of everything you could possibly want on a climbing expedition, say, of thirty hours. Cut out from this all that you think might be fairly easily dispensed with. Take with you 50 per cent. of the remainder. It is sometimes a relief to get free from a whole host of time-wasting and useless knick-knacks, such as a razor for instance (?), which civilisation has caused us to burden ourselves with.

It will be found that the weight of small extras, when added together, will mount rapidly. This will not assist us in doing so. All non-essentials should be as simple and light as possible. Replace the bulky, heavy drinking-cup of metal by a small, flat, folding leather one, the fountain-pen by the pencil-stump. Leave cigar-case and cigars at the hotel. Even the pipe is none the worse of remaining at the hut. The bunch of keys can stay down below also. The silver cartwheels of the Latin Union can be exchanged for paper. If you are a guideless climber, you will require neither corkscrew nor tin-opener. A small, strong pocket-knife is more useful, and a fraction of the weight, of the huge affair bristling with all kinds of useless "tools," including a gigantic hoof-pick for horses, such as is sometimes taken. Toilet articles are not wanted in a hut; the less washing at high elevations the better.

Do what you like, you will find, if guideless, that it is not easy to cut down the load of each man of a party of three below ten pounds.

A small siren for the Alpine distress signal should be taken.[1]

It is often a good plan to take a small folding pocket knife and fork, and small metal teaspoon of one's own, and even a tin mug; the last can be thrown away at any time. The huts are usually provided with a certain amount of iron or enamelled furnishings; but these are seldom clean, and it may save time to be

[1] See p. 142.

partly independent. A few safety-pins, a small piece of sticking-plaster, a strip of clean linen for a bandage, do not weigh much, nor do a couple of spare laces. It is important that *everyone* carries matches, in a suitable water-proof case. These are best of the flamer type. Cases have been known of a whole party of four finding themselves at tea-time without a single match; they had all thought one of the others would be sure to have some.

Lists should always be written out by one and checked by another member. It is surprising how easy it is for some small, yet important article to conceal itself, and escape being packed.

SECTION II

BRITISH MOUNTAINEERING

CHAPTER III

ROCK-CLIMBING

In the early days of the Alpine Club the would-be mountaineer generally began on snow, and in the Alps. Naturally a prejudice is apt to arise in favour of the means by which the climber has been first introduced to the delights of the sport. Much was written in praise of snow. The snow-craftsman, or, if one prefers, the icemanship expert, was stated to be the real scientific mountaineer; the rock-climber was sometimes termed the "mere gymnast." In more modern times the Alpine climber rarely begins abroad without some, perhaps considerable, experience on home rocks. The tendency is rather to over-emphasise the importance of difficult rock-climbing ability. The author is not a partisan of rocks, or of snow and ice. I think the mountaineer, to be "compleat," should be perfectly at home on both. There is this to be said about rock-climbing, however. In my opinion, to be a real expert rock-climber, on all formations, requires more science, practice, and brains than is necessary for the less varied and less complicated structure of frozen water.

A knowledge of geology is of no small use to all climbers, and is absolutely essential to the exploring mountaineer. The great difference in the constitution, lie, and behaviour of different rock formations will soon force itself upon the attention of the climber. He soon finds that he can take liberties with certain kinds of rocks which it would be criminal folly to attempt, if not impossible, with others. Some rocks,

such as the limestones, are never really safe to climb, at any rate with nailed boots. Others, like many of the granites, will show great smooth, unbroken slabs, thoroughly sound and secure, but "difficult" on account of scanty or rounded hand and foot holds. As a definition of what a climber means by difficult and easy rocks, I cannot do better than quote Dr. Claude Wilson's *Mountaineering* (1893): "Hand-holds and foot-holds are spoken of collectively as 'holds,' and when these are firm and plentiful the rocks are said to be 'easy.' On 'difficult' rocks the holds are scanty, or are so small and awkwardly situated that it requires considerable skill to make use of them." We thus see that mere steepness does not necessarily make the climbing difficult, though, of course, its moral effect cannot be entirely ignored. British rock-climbing, as a sport commonly pursued for its own sake, hardly dates back forty years. It has been declared "not mountaineering" by some Alpine writers. I would prefer to say that it is not the whole of mountaineering, but is a very important part of it. If combined with practice in winter in hill-walking and snow-climbing, such as is described in the next chapter, the British-trained mountaineer is fully deserving of that title, and need fear no difficulties likely to be encountered on any mountain-range in the world. He must modify his methods, and expand his horizon, on glaciers and the great snow-peaks. He has nothing to unlearn. He has been well grounded in the art of mountaineering. Alpine mountaineering has its origin in the pursuit of the little antelope called the chamois, or gems. The original British rock-climbers climbed the cliffs of our coasts and islands for the purpose of obtaining sea-birds, their eggs, and young. They were in the main islanders, and not highlanders, though a few in inland localities specialised in the destruction of the eyries of the Golden Eagle, and of the Erne,[1] or White-tailed Eagle, and in robbing

[1] Norse "örn," *Origin of the Iron and Heron Crags in Lakeland.*

the Peregrine Falcon of her fierce, and valuable, young brood.[1] A good deal of this cliff-climbing has been stopped through the operation of the various Wild Birds Protection Acts of the last half-century; in many places it is still carried on extensively. The St. Kilda group of islets, far out in the Atlantic, off the western coast of Scotland, are specially exempted from the scope of these Acts. The collection of the eggs, and the catching, killing, and salting of the sea-birds and their young, form a principal occupation of the islanders during the summer months. So important is climbing that, up to very recently, the ability to make the ascent of a special rock-stack was the test of a young man's marriage fitness.

The St. Kildans always climb barefoot. It is rather curious that, in the region of the most highly elaborated and difficult rock-climbing in the world, the English Lakes, a return is sometimes made, on specially holdless slabby pitches, to the primitive St. Kilda method. These islanders use ropes of twisted horse-hair. This probably keeps well under damp conditions, and is not affected by the fungi which so soon rot vegetable fibres.[2]

In the Shetland Islands, where egging is extensively carried on, the natives seldom use ropes. They mostly climb in stockings, slipping off the soft raw-hide shoes called "rivlins," commonly worn.

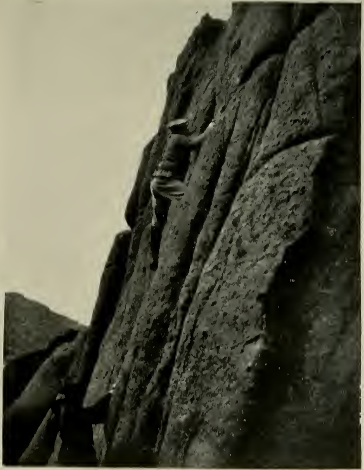
On the Yorkshire coast, at Buckton[3] and Bempton, where the greatest chalk precipices in Britain frown out over the North Sea, the cliffs are regularly worked by gangs of hereditary "klimmers." The method employed here is, however, not strictly climbing. The "klimmer" is lowered from above with a thick rope, and sits in canvas breeches. This is a severe test of nerve for a novice, as, in order to reach the chalk ledges under the boulder clay overhanging cliff-

[1] James IV of Scotland gave £180 for a cast of falcons.
[2] See *St. Kilda*, by Norman Heathcote.
[3] Buckton Cliff is 600 ft. high.

top, it is necessary to get a good swing on the rope by walking backwards over the edge, and pushing out smartly with the feet as the rope is slacked off.

I do not propose to give an account here of the origin and development of British rock-climbing as a sport in itself. It is now well established. There are nearly twenty British clubs in existence, mainly or largely interested in its pursuit, and a number of well-conducted periodicals, beautifully illustrated, are published by them. A number of volumes on the various districts by local experts have also been brought out. Reference to these books and periodicals will be found in the bibliography list at the end of this volume. The following short summary may be useful to indicate where British rock-climbing is to be found, and its probable character in the various districts.

The would-be British rock-climber, who dwells in the south and east of the island, is somewhat badly off for practice ground. Chalk, except for a short distance above sea-level, is everywhere unsound. Some scrambling has been done on Beachy Head, and in quarries, but is not to be recommended. Devon has coast cliffs, mostly of sandstone. Cornwall's coasts, and inland "tors," are of granite. These give in many places first-rate, but rather difficult, short climbs. Limestones, whether in scars or in quarries, give climbing in Cheshire, Derbyshire, Lancashire, Yorkshire, or elsewhere, which is only slightly less bad than the chalks. Derbyshire has a few small exposures of better limestone of a Dolomite character. Limestone, however, in most cases, is not justifiable in nailed boots. In Northumberland, Durham, Lancashire, Yorkshire, and Derbyshire many isolated crags, not of limestone, occur. These are, in the first two counties, mostly of volcanic rock; in the last three, of millstone grit. On these, enthusiastic local cragsmen have worked out many routes, some of very considerable difficulty. Millstone grit resembles in many



Eric Greenwood.

CLIMBING CRACKS. CORNISH GRANITE.

J. R. Young.

TORRIDON SANDSTONE. SUILVEN. THE GREY CASTLE.

ways a coarse, inferior granite, and weathers in much the same manner.

Scotland has many, if rather scattered, climbing centres. As pointed out by Dr. Wilson in *Mountaineering*, nearly thirty years ago, there is excellent climbing to be had within the confines of the Holyrood Park, at Edinburgh. The rocks of this ancient volcanic outburst are of basalt and tufa. The former is often good, if very steep and inclined to come out in angular blocks. The other is generally crumbly and rotten. Many similar formations extend in a belt across Mid Scotland from sea to sea, from Dunbarton Rock in the Clyde estuary, to the Isle of May and the Bass Rock,[1] at the mouth of the Firth of Forth. Much of the Scottish coastline, from Berwick to John o' Groat's, and from the Mull of Galloway to Cape Wrath, is precipitous. Innumerable rock-climbing problems, on almost every geological formation, abound. The interest of the ascent of a sea "stack," say in Shetland, is greatly enhanced by the difficulty of timing the landing leap from the prow of a Norway "sixern," poised on the summit of a great Atlantic roller.

In the Southern and Central Highlands there is too great a development of mica-schist rocks, with their strong tendency to a vegetable covering, to render the region of very great interest to the rock-climber pure and simple. These mountains, however, hold many, if rather recondite problems, and afford splendid training in snow and ice mountaineering. In the far North-West, the mountains are mainly of Torridon Sandstone and Quartzite. The scenery of this formation is striking, and splendidly individualistic, but, on the whole, the climbing is apt to be somewhat disappointing. The granite slabs of the Cairngorms, and of the island of Arran, give good practice in sound footwork; a climber trained upon these is much more likely to develop into a safe and competent mountaineer, than if he were to confine himself solely to the

[1] Bass = Hollow. A cave passes completely through the island.

standard "courses" in the English Lakes. Exceptionally fine rocks and climbing characterise the Nevis and Glencoe districts. The rocks here are mostly porphyrytic, geologically speaking, andesite lavas, and of extremely good quality.

Skye is a region by itself: it may be called the British rock-climber's paradise. The Black Coolins are like no other hills in Britain. For their brothers we must cross the North Sea to the Lofoten Islands, or to the Jotunheim district of Norway. Like the name Skye itself,[1] many of these Skye hills have names of Norse origin. The rock is of gabbro, a much younger rock than that which forms the most of Scotland. It is pre-eminently a good rock, and climbing can be done on it which would be impossible elsewhere in Britain. Even the ridges afford almost everywhere real climbing. Few peaks are readily accessible to an ordinary hill-walker. Great gaps and pinnacles constantly occur in and on these ridges, which are composed almost entirely of bare rock and stones, with very little vegetation anywhere. The faces and buttresses, also, are usually steep, bare rock. What makes the Coolins somewhat dangerous to the untrained climber is the fact that nearly every steep face and ridge is composed, *low down*, of a series of huge boiler-plate slabs which have been largely deprived of holds by the grinding and polishing received in the last ice age. The reality of Skye's resemblance to Norway is most strongly brought out by a visit to one of the lonely upper corries. It seems as though scarce a century could have passed since the hanging ice-cliffs of the glacier had ceased to poise themselves above the scored *roches moutonnées* of the corrie lip. The small dark tarn in the hollow above, might almost still contain the meltings of the vanished ice.

[1] Skye is Sky-a, the misty isle, a very appropriate name, as her high hills catch the first of the moisture-laden Atlantic winds. Sgurr nan Gillean looks Gaelic, but is gallicised Norse; the real meaning is Gillskar, or the scar of the gills, thoroughly descriptive. Scafell in Cumberland is Skarfell, or the hill of the cliff.

A. R. Thomson.

A GRITSTONE TABLE.

All rocks in Skye are, of course, not gabbro. Intrusive veins of other rocks, some of "good" others of "bad" quality, occur in the gabbro. The Red Coolins are of granite. The rocks at the Quiraing and the Storr are of a crumbly volcanic rock, of superlatively "bad" kind. These rocks are very dangerous.

Inland Ireland will not attract many rock-climbers, and her coasts, though fine, are rather inaccessible.

It is in Wales, and the English Lake district, that most British climbers will get their first introduction to the rocks.

For nearly forty years, the crags which jut from the faces of the highest English hills have been examined ever more closely for climbs of ever-increasing difficulty, and the process is still going on. Not even in the Dolomites, perhaps only on the climbing grounds nearest to Geneva and Vienna, is the standard of difficulty so high. It says a great deal for the skill, care, and prudence of the modern school of English rock-climbers that so few accidents occur here. Wales has a somewhat worse reputation. Perhaps, on the whole, the Welsh rocks are not so good as the Cumbrian and Furnessian, but the too numerous Welsh accidents are mainly of other origin. The condition of the rocks, *and* the condition of the climber, are both even more important than ordinary difficulty, in judging the suitability of a climb, and this must be considered, if unjustifiable risks are not to be run. Some of the worst of the Welsh accidents can be traced to the fact that "men shut up for months in a great city, have rushed to its difficult climbs with unbraced muscles and unstrung nerves." Disaster, under these conditions, is invited, and inevitable. British rock-climbers should treat the exceptionally severe climbs with as much respect, to say the least, as they would accord to difficult climbs in the Alps.

Comparisons, if not always odious, are often invidious, and can be made to lie as brazenly as facts by a fanatic, or statistics by a politician. Nevertheless, it may be

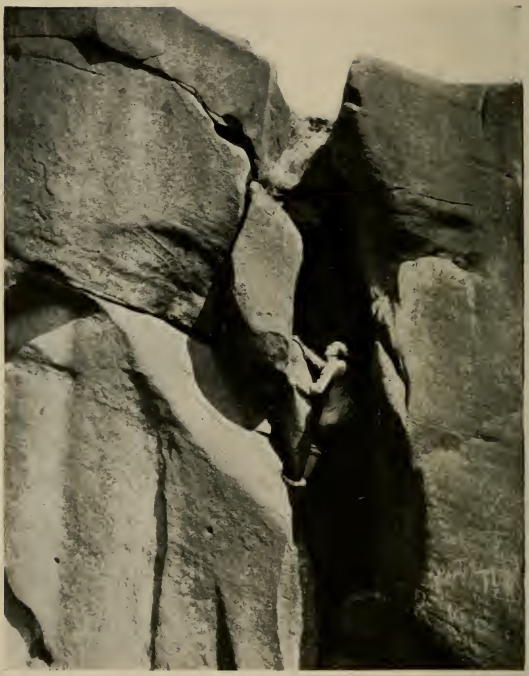
of interest, and perhaps useful to some climbers, to give here a comparison between a British and Alpine rock-climb, of some repute for severity. As the writer has led both, and is therefore not biassed in any way, I shall take the Kern Knotts Crack on Great Gable, and the so-called "Mummery Chimney" on the Grépon. Here, I must confess, there is no real comparison.

The Kern Knotts would be only a small incident in the Grépon day. Even to reach the foot of the "Mummery Chimney" may take hours of hard climbing: I have taken eighty minutes cutting the ice off the 150 feet of steep rocks below the foot of the chimney. The chimney itself is longer, much harder, and very much more sensational than the Crack. It is itself merely an incident, doubtfully the hardest, in the traverse of the Grépon. The ability to force one's way up the Kern Knotts Crack, or similar British climblet, does not constitute a man a mountaineer, or justify him in leading a party on the great Alpine peaks.

In the next chapter is given an imaginary account of a British rock-climb.

This has been made to embrace most of the ordinary incidents and positions on first-class British climbs.

General rock-climbing positions and methods are also dealt with in the account of an "Alpine Expedition," Chapter VIII, and in "Some Technicalities," Chapter XIII.



A. R. Thomson.

MILLSTONE GRIT. A CHIMNEY.

CHAPTER IV

A BRITISH ROCK-CLIMB

(See "Glossary")

Let us suppose the party to consist of three members, A, B, C. A is a skilled and experienced leader. B, though a novice, is active and athletic, and not troubled with nerves. C, like the leader, is also a strong, practised climber, though without A's natural and acquired abilities. Arrived at the foot of the crags where the climb is situated, they proceed to rope up.

The length of rope employed depends upon the character of the climb, and the constitution of the party. Twenty-five metres, or eighty feet, will usually be sufficient for three. A and C tie on at either end with bowline knots; B is put on the rope, somewhat nearer C than A, with a middleman knot. If much hauling of him was required, he would find the bowline-on-a-bight less painful.[1] The order is thus A, B, C.

Many continental climbers, and some in this country, consider that the order should be A, C, B. On the whole, and as a general rule, I do not agree with this. For specially difficult climbs (where, by the way, B should not be at all) without traverses, always in an upward direction, and where the climbing is known to be near the limit of A's powers, the order may be A, C, B, with some advantage. On the great majority of rock-climbs, and always on the great snow-peaks, the correct order, in my opinion, is A, B, C; that is, of course, unless A is in constant need of assistance, in which case he is obviously unfit for his position.

[1] See Knots, Chapter XII.

The climb is commenced in a "gully," to which a steep slope of "scree" leads up. The first obstacle consists of a cave "pitch," a black recess, roofed above by a projecting "chockstone." On the right the gully wall is vertical. It has a few ledges an inch or two wide, but too small to stand on at that angle, without good hand-holds, as it is impossible to balance. The left wall at the bottom is over six feet away from the right. It overhangs slightly, and gradually narrows to about four feet at the chockstone, which is about thirty feet above the floor of the cave. B does not see how it is possible to get up. A, however, does not hesitate. Saying to B, "Watch me, but keep under the chockstone for fear of loose stones," he proceeds to tackle the pitch. On the minute holds he mounts the right wall for about ten feet; as the holds here almost die out, he then throws his left foot across to the left wall, which it now just reaches. With a thrust from this he is able to reach a hand-hold higher up. As the cleft narrows he gets better purchase, and, grasping the edge of the chockstone with his hands, swings up his legs and disappears. Presently he calls down, "Righto, come on, B." B now starts, and, coached by C, finds it not so bad after all. As he nears the top, flushed by success, he makes a too-eager grab for the top of the chockstone, taking the pressure off the left foot just a fraction of a second too soon. Result, the nails slip, and down he goes, or would do so, but for the fact that A, who has been just "feeling" him up with the rope, holds tight. B only slips down the stretch of the rope. Disliking the position and pressure, he seizes the rope in both hands, and proceeds to climb up it. In doing this B commits what, in my opinion, is one of the worst of the "crimes" of the bad climber. He is submitting his leader, not to speak of himself, to a wholly unnecessary risk. Few are the amateur climbers, and there are even fewer among the guides, whose fingers can be trusted to stand such a strain for more than a few feet. When a follower is

Ruth Raeburn.

BACK-AND-KNEE; RESTING.

R. Adam.

FINGER-AND-TOE TRAVERSE, TUFA.

moving, there should be no slack on the rope between him and the man in front. The higher B hauls himself the greater the bight or slack formed. Should B's fingers slip from wet or ice, or give out from overstrain, it is unlikely that A could stand the frightful jerk which would ensue. No doubt most athletic men can get up a few feet in this fashion; but it is a very different thing ascending a thick dry rope clad in gymnasium costume, and climbing the same distance up a thin, greasy, wet, or icy, hard climbing rope, clad in heavy clothes, in nailed boots, with a loaded rucksack, and with fingers already tired with hard climbing.

If B cannot climb the pitch unaided, or it is desired to save A's strength, there is no objection to using a doubled rope, or emergency cord. B pulls up on this, while A assists him as much as is required by the waist-rope.

B, however, just manages it, and, puffing and struggling, hauls himself over the top of the chockstone. He has quite forgotten, however, A's warning about loose stones. His flounderings disturb a perfect torrent of boulders, which bound down the pitch, striking the walls with terrifying din. None, fortunately, strike the rope, and C, who "has been there before," is well out of reach below the chockstone. A remarks to the remorseful B, "Take it easy, *press down*, and the stones will never waken."

C now comes up, B just feeling him on the rope. When he is near the top, remembering his own struggle, B begins to haul vigorously. At once comes up an indignant shout from C, "Slack O." A says, *sotto voce* to B, "Don't haul unless you know it is required, C particularly prides himself on neat 'back and foot' work." C, who is a tall man, with long legs, puts both feet against the left wall, and hoisting himself up thus, steps easily on to the top of the chockstone.

The moral here is, that meticulous literary descriptions of climbs, with every hand-hold labelled, are of very

slight value. Hardly two men will climb the same pitch in exactly the same way. The general methods are always the same, but each climber must find out for himself, the way of applying them which best suits his particular build and capacity.

Again united, the party proceed towards the next difficulty. The intervening part of the gully is at an easy angle, with many loose, sharp blocks and several low, rotten pitches. The climbers keep close together, carrying the shortened rope in coils in their left hands, and all moving together. They soon arrive at the next pitch. This, A remarks, "is a bit of a 'muffin struggle.'" The gully here narrows to a crack, too small, it appears to B, to even admit his body. Higher up the crack gradually vanishes in an overhanging wall. The walls of the crack are quite smooth, and the cliffs on each side vertical or overhanging. To B the place looks utterly impossible; but A seems quite cheerful. The crack penetrates far into the rock, but in its jaws near the outside are caught two boulders about eighteen and twenty-four feet respectively above the floor. The crack proves much roomier at the bottom than it looked, and A here mounts on C's shoulders, which C has carefully padded with a scarf and two pairs of gloves. A leaves without delay, as he knows it is not pleasant to have a nailed comrade on one's shoulders even for a few seconds. C assists A by supporting his feet, until the leader, puffing and struggling, gets out of reach. A's progress is almost entirely by scraping the sides of the holdless crack with the edges of his boots; the fact that he is wearing narrow boots, with sharp new edge-nails, is of great advantage. Rest is taken by inflating the chest and stiffening the muscles of the arms. Fortunately the ascent is neither very high, nor directly perpendicular, but slanting out towards the lower chockstone. After some strenuous minutes A reaches this, and mounts to its top. He can now reach a hold on the upper chockstone, and a few seconds later is standing on it and

resting. When he is ready B follows, and with the good take-off from C, and some slight assistance from the rope, is soon on the chockstone beside A. B has been wondering how C, who is taller, broader, and heavier than either of the others, is going to manage, when A shouts down to C, "Rope off?" and, getting for answer "Yes," pulls up the loose end and coils it where it will not get foul on the chockstone. He explains to B, "We'll pick up C later; watch me and the rope now." A then steps into a crack with his left leg. This crack, which runs up the right wall, sloping upwards and outwards, was unnoticeable from below. It looks horribly dangerous to B, but the leader, with one leg inside, the right knee clasping the edge of the crack, swarms up somewhat in the manner of climbing a sloping tree-trunk. Soon he reaches the edge of the wall, crawls round a corner, and disappears. Presently his face again shows to the anxiously watching second, "Come on" is all he remarks, and B comes on. As before, he finds it easier than it looked. He is soon beside A, and to his surprise finds they are on a big ledge, with grass, and with room to move about. After resting a few minutes here, they proceed to pick up C. Descending the face some little way by fairly easy ledges, they arrive at a grassy corner. Looking over, B sees C only some thirty feet below them, standing at the bottom of the pitch. The intervening wall is A.P., or "Absolutely Perpendicular," and without holds. A's remark is, "If you have thews, prepare to use them now, as this is a big fish we have to land." He tells B to come off the rope, and then throws the end down to C, who, wise man, ties on with a bowline on a bight. A now digs two holds in the turf for his heels, and, passing the rope round the small of his back, directs B to sit down in front, and haul in unison with him. The hauling is done with the legs rather than with the arms. It is at first very hard work, as C can give no assistance; but the third man, nevertheless, comes dancing lightly up the face of the rock, like the

wall-creeper, the butterfly-like bird, the *Papillon des Roches* of the Alps.

The lift gets easier as C mounts higher; there are some projections here which he can utilise to ease the strain both on his haulers and on himself. Had a spare rope been carried, this lift would have been much easier, as it could have been used as a "stirrup-rope,"[1] and C could have got up with very little assistance, by bending and straightening the thighs, the others merely taking in the slack of each rope alternately. Thus, even at ninety degrees, climbing can be done walking.

After C is up the whole party are quite ready for a quarter of an hour's rest. Re-roped as before, they then resume the ascent. The descent of A and B is first retraced to the top of the groove. Directly above this the cliff actually overhangs. Some distance on their right appears a steep, broken arête; to this a flat but narrow ledge leads. The wall above the ledge appears vertical; B can see no holds in reach upon it. A does not look for any. While B and C look after his rope, paying it out carefully, he steps upon the ledge and moves slowly and steadily along it, holding his head sideways. His hands spread, and his arms at full length, make him look almost as if nailed to the wall. Presently he gains the arête, mounts quickly, and sits astride a small pinnacle. "All right," he calls, and B now starts. When A was on the ledge B had thought the wall vertical. Now he is sure it is off it—on the wrong side. He says he would prefer to kneel; "All right," says A, "but come on." B therefore shuffles across on his knees, and feels less off his balance in this position. A, whose rope is only slanting slightly above B, is very careful not to put the slightest tension upon it during the traverse. C carefully pays out his end, seeing that no check occurs while it runs out. He has also belayed himself to a large spike of rock at the beginning of the ledge. Arrived in safety on the other side, B is very

[1] See Chapter XI.

pleased to find good holds on the arête. He soon mounts and strides the pinnacle below A. C then starts. His height is here against him, and, if it were not for the chance that his superior reach just enables him to obtain one or two hand-holds quite beyond the others' utmost stretch, he would have had to adopt the kneeling tactics of B.

Experience would seem to show that the best all-round climber and mountaineer is the somewhat lightly built man of medium height. The extra tall man has an advantage in certain places, owing to his abnormal reach. His height may be a disadvantage on others. The very short man, on the other hand, may find passages quite out of his power which a much inferior climber of normal reach finds quite easy. For long, hard, enduring work, preference should rather be given to men slightly under than much over middle height. Most good sprint-runners are big, heavy men. The long-distance man is small and light. The usual trouble with men of abnormal height and muscle is, that like badly designed aeroplanes, they make poor climbers, on account of a too low ratio of engine-power to load. The small man is not generally lacking in stamina, is often stronger, in relation to weight, than the big man, and, most valuable of all, is usually quicker. As an example of a climb where height is of special advantage, I may take the North Climb on the Pillar Rock in Cumberland. Here the route over "The Nose" can be done by the tall, strong, experienced leader without risk. For the short man this passage can never be quite safe.

As C comes along the ledge his rope is drawn in by B, who has to hold it in his hands, as his position is not secure, and he has no hitch available. Perfect safety for the party is obtained by A, who *is* secure, and, with a good hitch, drawing up B's rope over the hitch till it is tight, and thus "backing him up." [1]

When C has got holds on the arête the party all

[1] See Chapter VIII.

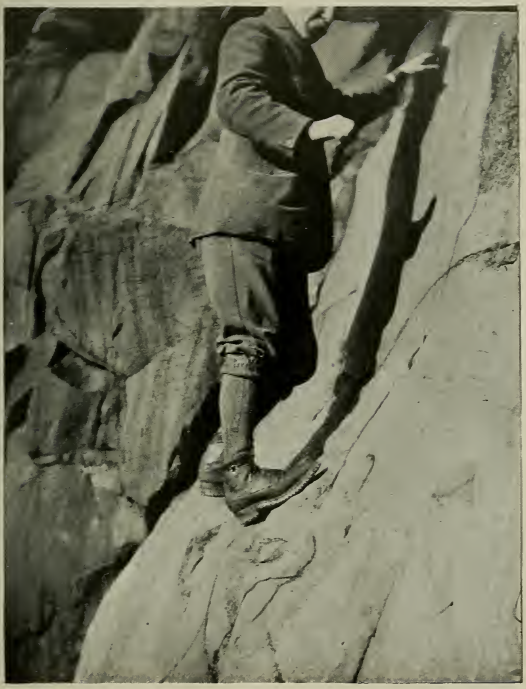
move on. The route now lies for a while up a steep and sensational ridge. It is, however, well broken up, of very sound rock, and they mount rapidly. This kind of climbing is, perhaps, the most enjoyable of all. There is every appearance of danger, practically none of the reality. Hitches are abundant, and, if the arête is sharp, are available on both sides.

Moderate arête-climbs are most suitable for beginners who lack confidence in themselves. They teach that real safety often lies in the airiest positions. They help to banish the mental and moral illusion that it is necessary to suffer from giddiness on the heights.

Writing from a wide experience of novices of all ages and both sexes, I can say that very few people are incapacitated from climbing by dizziness. If the novice is interested in the climb, and has confidence in the leader, the necessity of becoming dizzy will soon be forgotten.

Higher up the ridge widens out to a rounded buttress, at the foot of which is a broad, but badly sloping outwards, ledge of bare rock. Above, for about sixty feet, the rocks are very steep and smooth. Though there are ledges here and there, all have the same outward tilt as at the foot. B here comes off the rope, as A will require to run out nearly the whole of it before he stops. A says, "This is the only nasty bit on the climb, and not for a booted leader; mine, at any rate, are coming off." He therefore sits down and removes not only his boots, but his stockings and socks also. He then replaces the stockings. It should be most carefully noted that slabby rocks should not be climbed in double stockings: this is dangerous.

While A now starts up the slabs, B and C sit down on the ledge, which is hitch-less, backing each other up, and prepared to pull in the slack of A's rope should he produce any by falling off. A does not produce any. He climbs slowly and cautiously, mostly using the palms of the hands and the whole flat of the foot. Though he moves slowly, he moves continuously, and is at the top in a very few minutes.



R. Adam.

A SMOOTH SLAB.
The limit of adhesion.

The others come up one at a time in boots, C carrying both his own and A's sack ; they can ascend easily and safely with only a comparatively slight pull on the rope from A.

Above the "nasty bit" the climbers arrive at the top of a tower or "gendarme." From the far side of this a short, steep descent leads to a narrow "knife-edge." This is level at first, but rises at the end to the final steep part of the climb. C is quite capable enough to take the responsible part of last man here. If B had been in that position a rearrangement of the rope would have been necessary ; changing the rope here would be very inconvenient; to let B come down last might be dangerous ; one or other would have had to be done on the A C B arrangement. Towards the end the knife arête slopes up somewhat steeply in slabs. A walks easily and quickly up these ; B prefers to stoop down and get his fingers into some diagonal cracks ; this he finds reassuring.

The last difficulty is now encountered. It is a "mantel-shelf," about seven feet high. A skims easily up this. B, whose gymnastic training stands him in good stead, makes a better job of it than C, whose weight is here against him. Soon after they reach the final summit. None are sorry to reach it and to rest, contemplate the views, and investigate the contents of the lunch-sacks. B is surprised to find that they have taken four hours over the ascent of six hundred feet. Nothing is so surprising as the way time vanishes on a difficult rock or ice climb.

It will be noticed that the styles of the three climbers differ widely. Taking them in order, A is what may be called a "finished" climber. His style is smooth and flowing ; it is also polished. He moves with an apparent absence of effort which is often puzzling, sometimes a little irritating to more powerful, though less practised men. He seldom requires to stop and look about for holds ; these appear to fall into his hands, or come under his feet of their own accord.

His feet seem to have developed a separate intelligence of their own ; they know, at once, just the pressure and direction of it necessary to prevent slipping. Though he does not move fast, and on a short, difficult piece of 20 feet in height he may be beaten for speed by B, on a similar climb of 200 feet B would be left far in the rear. The reason is that A moves continuously, is never spasmodic or jerky. On a descent these characteristics are even more marked. He appears to almost slip from hold to hold. Not an ounce more force is used than will just keep the law of gravity under control. B is, as has been said, a novice, but he has the makings of a first-class climber. He has strength, courage, enthusiasm, and " dash." The last quality has been deprecated by some authorities for the young mountaineer. I would prefer to say, " Be prepared, then dare." The youthful climber wholly devoid of the youthful quality of dash will never make a really first-rate mountaineer.

C, though lacking the supreme climbing abilities of A, is yet a good climber, and an excellent man to have in a climbing party, especially a mixed one. His strength, coolness, and experience will prove a tower of safety to it. He has the knowledge of his own limitations and the good sense not to exceed these. He may often be, though not the actual climbing leader, the " general " of the climbing party, and responsible for the main line and plan of the attack, while A does the detailed and physical leading.

Some of the famous guides, and many of the amateurs, of early Alpine exploration, were of this type. Perhaps the best-known of these guides was Alexander Burgener of Saas, Mr. Mummery's guide in the Alps.[1] In few, if any, of the difficult rock passages did Burgener do the leading, a younger, lighter man was put forward. Yet to Burgener must be ascribed most of the credit for the success of the climb.

[1] In *The Pioneers of the Alps*, by Mr. F. Gribble, Burgener is stated to have been Mr. Mummery's guide in the Caucasus. This is an error.

CHAPTER V

SNOW-CLIMBING IN BRITAIN

TIME, PLACES, AND CONDITIONS

SNOW is, as everyone is aware, a very variable substance. From the light, air-filled flake, which hardly seems able to make up its mind to alight, but flits butterfly-like along a hill-side, to the heavy, sodden substance we call sleet, run its gradations. Again, it may take the form, in falling, of minute ice-crystals. These, again, may be gathered up by the wind, and blown and consolidated into great banks, cornices, and drifts. This form of snow, driven by a gale, will be found to penetrate right through ordinary clothing, and may prove fatal, unless clothing be worn which is able to keep it out.

It is, of course, the snow, which, falling all the year round on Alpine heights, gradually, as it slips down, consolidates into those extraordinary rivers of ice which we call glaciers.

Britain's Atlantic position, and her warm winds in winter, have, in the present age, prevented the formation of any true glaciers, in spite of the high rate of moisture deposition. Their prevalence in earlier times is very clearly seen in the moraines, perched blocks, scratched and rounded rocks (*roches moutonnées*) at the present day so obvious and abundant in many places.

In order, then, to learn glacier work, where the crevasses run, the best passages through ice-falls, and similar details of Alpine ice-work, we must go abroad. Every one of the many other details of snow-craft and icemanship may be acquired within the limits of

Great Britain. It is true we have no "long slopes of bare black ice," but we can console ourselves with the knowledge that no slopes answering to that description are ever climbed in the Alps.

We have, however, long steep slopes of a very hard and tough substance upon the highest faces, of north-east aspect, of our homeland hills, in late spring and early summer. This, which gives most excellent practice for ice-axe, crampon, or nailed boots, we may call snow-ice or *névé*. The condition does not appear common in the Alps. Dr. Claude Wilson, who, as well as others, remarks upon its occurrence on the Brenva route of Mont Blanc, considers it to be due to "great cold and enormous pressure." It would, however, seem more probable that it is caused by a rapid alternation of frost and thaw, such as is a very common phenomenon both on the south face of Mont Blanc and on Ben Nevis.

I quote here three descriptions. The first in date is taken from a paper written by me for *The Scottish Mountaineering Club Journal*, vol. ix., 1906, entitled "Scottish Snow." The other two are from the *Alpine Journal*.

Nevis.—"These blocks exhibited all the tenacity of Scottish *névé* in late spring. If struck by the pick no result is produced; it merely sinks in and remains. The only way to make any impression on this toughest of snow is to cut a groove with the adze, and drive out the piece with the pick." I compared this substance to a combination of the two proverbially opposed substances, chalk and cheese.

Mont Blanc.—"Short stretches of ice of the colour of Plaster of Paris, were encountered, so tough and unbrittle, that the axe-head simply stuck in them, without bringing anything away" (Captain J. P. Farrar, *Alpine Journal*, vol. xxvi., 1912, page 171).

"Steep, slippery ice of a hardness unknown to us before, and with a curious quality unique in our experience . . . a quality of viscosity. The pick had

J. R. Young.

NEVIS, FROM CARN MOR DEARG. APRIL.

The rock in the lower right-hand corner of the picture is 600 feet high.

often to be wriggled out, bringing very little away" (Dr. Claude Wilson, *Alpine Journal*, vol. xxvi., 1912, page 274).

Though a certain amount of snow-climbing and ice-work is to be obtained on the English and Welsh hills in winter, it is naturally on the higher and more northern Scottish peaks where the conditions most closely approximate to the Alpine. The more southerly snows rarely lie long enough to get consolidated into the tough, reliable substance which we call snow-ice.

On the highest Scottish hills the snow lies, on northern and eastern slopes, for many months of the year. In fact, in a few places, in gullies and corries, it never melts. These masses of snow-ice have been treated of in meteorological and geographical journals, as British glaciers, but the hard, tough substance of which they are composed is hardly true glacier ice.[1]

On Nevis, and on our highest hills, snow may fall any day in the year. It is, however, usually not until November is well advanced that it lies in any quantity. A mild December may see the Bens almost bare at New Year. After that date winter really sets in, with a deepening and a hardening of the snows. There is much less likelihood of a warm Atlantic gale causing, as I have seen at New Year, three feet of snow to vanish in two days, and raising the temperature, at 4,000 feet, considerably above the average July temperature at that height. For nearly five months after the turn of the year the snow deepens and the cornices increase in weight above the N.E. faces. Even mid-June may see only a partial stripping of the snows. At the end of the first week in July, I have enjoyed a standing glissade of over 600 feet in a Nevis corrie. On a visit towards the middle of June, the party found all the rock ascents impossible, everything buried in ice and snow, and only succeeded in making the ascent of

[1] The Rev. R. P. Dansey, *Symon's Meteorological Magazine*, 1905. Victor H. Gatty, *The Geographical Journal*, 1905, "The Glacial Aspect of Ben Nevis."

one of the gullies, and evading the 20-foot cornice at the top, owing to the keen frost, and the admirable condition of the tough snow-ice filling the gully. The little hotel was at this date completely buried, and of the observatory on the summit only the tower protruded from out of the huge drift burying the rest of the building. In September heavy falls may cover the upper 1,000 feet of Nevis and the Cairngorms with a foot or two of new snow. Even in August quite heavy falls may occur.

Avalanches.—These are many, and of formidable size, apart from exceptional slides such as are described in *The Loss of Gaick*, where a hut with a party of deer-stalkers was swept away.

A warm, muggy day in late April or in May, will see the precipices and gullies streaming and thundering with the avalanches of falling cornices. These sweep down for two thousand feet, often bearing with them great rocks torn from the cliffs. Gullies in such conditions must be most carefully avoided, and indeed should not be attempted unless frost prevails. They are often safe in bad weather which is also cold. Snow in Scotland alters in condition even more rapidly than in the Alps. Sun has less influence, in inducing a state of rottenness, than a warm south-west wind from the Atlantic. Climbers then should follow the ridges. If more difficult than the gullies, they are much safer.

Ice-falls.—The ice-falls referred to by Tennyson as "Firths of ice, which huddling slant in cloven frozen falls, to dash their torrents out of dusky doors," are, of course, not met with in Britain. Our ice-falls are frozen water-falls in gullies. These give climbing, which is usually much more difficult than any ice-work likely to be necessary in Alpine ice-falls. The practice in axe-craft and iceman-ship is first-rate, but they must be attacked with discretion. The leader of the party, at any rate, should have had a lot of practice in general mountaineering, before venturing on this difficult kind. The first description of the splendid

THE SCOTTISH ALPS IN SPRING. *J. R. Young.*

A SNOWSCAPE. GLISSADING. *J. R. Young.*

sport to be obtained in British ice-falls is by Dr Norman Collie, and will be found in *The Scottish Mountaineering Club Journal*, vol. iii., page 1. Many other accounts of such climbs are to be found in later numbers of that journal, and in other British climbing journals.

Cornices.—These are very usually present, often of great size, on all places similar to those where they occur in the Alps; ridges, tops of gullies, and edges of plateaux. British cornices are seldom of actual ice, but are often built of snow-ice of extreme toughness; their debris often survives in great blocks, after a fall of nearly 2,000 feet.

The cornices at the head of the Nevis gullies have been bored through on more than one occasion. On the first of these a very strong party of Alpine amateurs took two days to get through, the intervening night being spent at Fort William. A Nevis cornice has been noted which was forty feet in height.

Real ice practice, on ice as a rule much tougher than ordinary low-level glacier ice, may be often found on the flood waters frozen on the slabs of the upper corrie lips.

The snow and ice work generally on the steep sides of our highest peaks is considerably more difficult than ordinary Alpine snow and ice work.[1] Before making any of the larger expeditions, it would be well for the complete novice to obtain experience by hill-walks in snow, and by the ascent, traverse, and descent of steep slopes of hard snow on lower and easier peaks. It will soon be discovered what splendid stuff "good snow" is; how its presence often gives safe and reliable holds just where they are wanted. Knowledge will be acquired, perhaps unconsciously, of when snow can be trusted and when it cannot. Realisation will come of the only safe

[1] For a comparison between a Nevis ridge in ice and the Zmutt Arête of the Matterhorn, also under ice, see *The Scottish Mountaineering Club Journal*, vol. ix., 1906.

method of dealing with snow and ice, the "Absolutely Perpendicular" attitude of body. How to carry and use an ice-axe neatly and handily will soon be learned, as well as many other points of learning in the lore of the snows. This knowledge may prove invaluable on Alpine heights.

Glissading.—By far the best place to learn glissading is on the lower hills in spring. There the conditions are more favourable for this method of Alpine travel—great fun and sport in itself—than on Alpine peaks in summer. In the Alps, in usual summer conditions, most places really suitable for glissading are then usually bare of snow. If snow is still left, it is often hard and bumpy, ridged and furrowed. Glissades are short, difficult, and fatiguing, and it is practically impossible to glissade in "good form."

The inferior kind of glissade, the sitting, is even more seldom safe or possible in the summer Alps than is the standing.

Old winter avalanche snow has been recommended as practice ground in summer. This is, however, about the worst kind of snow on which to learn; correct style is usually impossible, and the fatigue inordinate.

Those who are good ski-runners will require little teaching in standing glissades. Glissading is really a form of ski-ing. There are two methods in both. The beginner, the timid, and the man devoid of balance will adopt the "stick riding" method, though in glissading the stick, or ice-axe, is not held between the legs. On good snow, at a sufficient angle, the expert glissader's attitude is exactly that of the ski-runner, only, as his pace is not so fast, he does not lean forward so much; he is almost exactly upright. He does not use his ice-axe as a prop, leaning back heavily on it. This is excessively fatiguing to the arms. The axe is used as a rudder, or emergency brake, both auxiliary to the feet. Pace is for the most part regulated by rising on the heels to check the speed, by pointing the toes down to increase it. In really good conditions,

J. R. Young.

STANDING GLISSADE.

J. R. Young.

SITTING GLISSADE.

the axe is lifted altogether and carried in front of the body in both hands, ready to be applied at once where wanted.

The good glissader does not stand stiff as a doll, with feet splayed and level, nor does he straddle his legs and lie back on his axe, as exhibited in photographs of bad glissaders or bad conditions. He stands almost bolt upright, leaning ever so slightly forward. One foot has a decided lead, the other follows behind slightly to one side, but not straddled out. If a sudden check occurs to the splay-footed, level-toed slider, he is almost sure to lose his balance. On the correct method, when the check occurs, the after foot is at once swung forward ; perhaps even a short run is inserted in the slide, without interrupting its even flow. The method, in fact, is very similar to that adopted by the bold, confident small boy on an ice-slide, and is equally successful.

In fast glissading the front leg is very nearly straight : when the going is slow, and the toes have to be much pointed down to bring the flat of the foot to bear on the slope, then both knees must be somewhat bent. When the snow is furrowed, hard, and bumpy, a certain amount of leaning back is necessary. This is what makes Alpine summer glissades usually so unsatisfactory and fatiguing, as the strain on the arms is in this case severe.

Roped standing glissades, like roped ski-ing, are theoretically possible. In practice, two, I think, will be found about the limit for such a party, and then only if both are experts. In glissading, as in climbing down, the best man goes last.

It is probable that good glissading would be obtainable in the Alps in June and early in July, but then the peaks might be inaccessible. Personally speaking, I have found the best glissading, in Scotland in late spring, and on the Continent in Norway and the Caucasus early in July. On a number of occasions heights of 2,500 to 3,000 feet, were descended in not many more

minutes than the ascent had cost hours: notably 2,500 feet down the top cone of Elbruz.

On a very steep slope, I believe the glissader will beat the man on ski every time, as the latter must, of course, zig-zag, or swing. No rule can be laid down for glissading angles: condition of the snow is even more important than angle. Glissading should never be indulged in when there is the least chance of starting an avalanche. The knowledge of this belongs to the general technics of mountaineering.[1] The warning applies even more strongly to the sitting glissade.

Sitting Glissades.—This is an altogether inferior method of glissading. Though it may not seem so, it is in fact much more likely to cause damage to the glissader (or his clothes) than is the standing. The fact that it is done on much softer snow, and at much lower angles, tends to conceal the fact of its greater relative danger.

Control is really more difficult on the sitting method. There is almost always a tendency for the snow to pile up under the slider until control is lost. When this happens the slider should roll or wriggle sideways with the aid of the ice-axe, until a new and thinner layer of snow intervenes between him and the under surface. If this is done habitually on safe places, where it does not much matter if control is lost, it will be easier to carry out should an emergency arise.

It has been stated that the best method of control, in sitting glissades, is to grasp the ice-axe by the shaft, and to use the pick, or even the adze, as a brake. With this I am wholly unable to agree. The safe position on a steep, hard snow slope is bolt upright on one's feet, because then, apart from the axe, we can apply in the most effective manner the couple of hundred or so small sharp brakes we possess on the soles of our climbing-boots, and these are pressed against the surface with the whole weight of our upright body. If we are on a sitting glissade, come on a harder place or a

[1] See Chapter XIII.

higher angle, and wish to stop or assume the safe position quickly, we use the ice-axe.[1] We must use it in such a manner that it will not be lost. Should we attempt to stop with the pick or adze while moving at any pace, the slope gets the axe, not the "sloper." Even if we do manage to brake at a low speed, by holding the axe by the head, and applying the pick as low down as we can reach, this will almost certainly result in injury to the hands.

Both methods are wrong in principle, and are not necessary. To avoid risk of losing our safety-stick we hold it thus: the axe-shaft is grasped near the head by one hand, palm upwards, the lower hand grasping it by about the middle, palm downwards; the *spike* is then pressed into the snow, on either side, as steering or braking is desired. Pressure, from a few ounces to more than half the weight of the body can be brought to bear upon such a brake, and taken off again, and this as quickly or as gradually as desired, by raising the body on the lower arm and heels, and stiffening or relaxing the legs.

An anchor—that is, an ice-axe pick—is not shaped or suitable for a brake, which depends for real efficiency on its gradual application. Applying the principle to rock-climbing, the parallel is between the bad and wrong method of "belaying" a rope *round* a hitch and the correct method *over* a hitch.

Couloirs in the Alps are sometimes glissaded; so are douloirs at home. It should be remembered that such places usually possess *bergschrunds*. These, at home, may not be open, but will probably exist at a steep drop or pitch in the bed of the gully. The stream, in the late spring, may be running underneath, and nothing but a thin skin of snow left above to act as a trap. Accidents have happened to incautious glissaders at such places. The famous French climber, M. Henri Cordier, was drowned in Dauphiné through

[1] For instance, the top part of our slide may be in sun, the lower in shade.

falling into such a trap. Their probable place of occurrence can be clearly observed, in many cases, by the increased angle of the gully-bed, or the contour of its sides. Steep gullies with known schrunds, or weak places, if glissaded, should be done in stages with a long rope.

Roped sitting glissading may also be done to aid a beginner and teach him his controls. It is, like roped ski-ing, difficult to work, and often painful and unpleasant, unless all the party are experts.

Beginners at sitting glissading should have previously ascended the slope they propose to descend, or should know at any rate that the slope does not suddenly increase, or finish on ice low down. If the course is strewn with boulders which project above the snow, if glissaded at all, control *must* be retained. Weak, open, or iced spaces commonly exist round such boulders, and, unless given a wide berth, an unpleasant jar, to say the least, may occur.

Those who first attempt the sitting glissade will often find, if the snow is somewhat hard, that a very cold substance can generate a very considerable amount of heat. The following quaint and amusing account of his experiences is taken from the narrative of the Baboo Sarat Chandra Das, who was sent by the Indian Government over the Himalayan passes to Lhassa.

"I girded up my clothing, and, holding the edge of the lower part of my robe, slipped along. Instantly I was carried down and hurled to a depth of more than a hundred feet below. There I brought myself up by fixing my elbows into the snow like a brake, at the same time lifting my hinder parts a little. . . . In the third slide we met with slippery ice, rather than snow crystals, and consequently got pains in the back, caused by friction on the hard substance." The Baboo's method of braking is effective only in very soft snow; usually it is too painful, as well as destructive to the clothes, to be employed. Sitting glissaders, at any time, should see that they wear "knickerbockers

garnished with a double seat." Guiding and checking with the heels is quite effective. It has, however, the serious defect when the pace is good, and the snow at all soft, of driving a stream of snow against the face. This can be extremely painful.

Ski

It would be impossible to deal with mountaineering nowadays without mention of that splendid allied sport, ski-running. Mention of it, however, will here be brief: the sport has now a huge number of clubs for its propagation and practice, and a great and increasing literature of its own. It is, perhaps, next to mountaineering, the finest and most exhilarating sport in the world. Its importance, as an aid to or part of mountaineering, has in my opinion been greatly exaggerated. After all, the angles and terrain suitable for the ski-runner are just those tedious and uninteresting for the mountaineer. Lest it be thought that I write with prejudice, I may mention that I learned ski-ing, before knowing anything about mountaineering, in Norway, as far back as 1892, and traversed the same year several Scottish hills. The result of my own experience since, and a study of Alpine, Caucasian, and Himalayan ski-ing, has forced me to the conclusion that, except sometimes on the lower slopes of the Alps in winter, skis are far more trouble than they are worth to the mountaineer. As regards the Caucasus, Messrs. Egger and Miescher took skis with them on their ascent of Elbruz (18,500 feet) in 1914; but I do not gather that, as time and labour-saving aids, they were of any use, while I am quite sure that, if our party who made the climb in 1913 had been burdened with skis, we should certainly have failed to get up. The fact is that climbing on skis is, unless at easy angles, desperately hard work.

In winter, a man on rackets will often easily beat the man on skis on the ascent. The joy and beauty of the ski is only developed on the descent. For the purpose

of obtaining this exhilarating pleasure, ski-ing uphill is well worth while: for climbing steep peaks it is unsuited. Non-slipping irons, ropes, and crampons have been sometimes used on skis. It seems tolerably certain that at places where these are of any use, it would be easier to put the crampons on the feet and drag the skis. Himalayan experiences seem to bear out Caucasian; skis are not worth their weight. Dr. Jacot Guillarmod states, in *Six Mois Dans l'Himalayas*, that on his party's several months' siege of K2, when Dr. Wessely and he reached a height of nearly 22,000 feet, that he found skis useful on *one* occasion.

In Britain we are too much under warm Atlantic influences to make even winter ski-ing either certain or widely popular. As a rule, the snow is either soft and sticky stuff, or hard, thin, and icy. If the British mountaineer cannot get to the Continent to learn the allied sport, he should seek hilly places farthest removed from the sea. In England this will be Derbyshire, in Scotland the watershed of the Tay and Spey basins near Dalwhinnie, or the head of the Dee Valley above Braemar. Here, in February, March, and April, he may get a few days' good ski-running.

Though ski-running is not, in my opinion, mountaineering, the two sports react on one another. A good ski-runner has all the makings of a good mountaineer, and a good mountaineer will become an expert ski-runner in a fraction of the time a non-mountaineer will take to learn.

The following chapter is not an account of any particular ascent, but contains descriptions of most of the difficulties likely to be met with on a first-class British snow and ice climb. Many easier climbs are to be found, some more difficult have been done.[1] The aim is, as with the Alpine ascent, to give a general picture of the conditions.

[1] See *The Scottish Mountaineering Club Journal*, "A Scottish Snow-climb."

CHAPTER VI

A BRITISH SNOW-CLIMB

The party consists of four friends, the time is mid-April, and the climb they propose to make is that of a 4,000 feet Scottish peak from sea-level, and by way of a gully and ridge on its north-east face.

Of the party, A is a thoroughly capable mountaineer, with all that that implies. D is a man who has had a lot of experience in the Alps with good guides. B and C are strong and active British summer cragsmen.

It is a pleasant, sunny, but sharp morning, with a faint air from the north-east, as they leave their sea-level night-quarters at seven a.m. Six o'clock would have been more suitable had the party been a little less strong and capable. They carry 100 feet of rope, two lanterns, plenty of food, and their woollies, spare and working gloves, helmets and extras, are rather more and warmer than for Alpine work. The ascent they propose making is longer, harder, and considerably more difficult than most one-day Alpine expeditions.

The snow-line lies at a wonderfully uniform height of about 2,000 feet above the sea. The ground beneath this is bare, except for a few drift-patches, and is covered with long, dead bracken-stems and the bleached grass of last year; the turf under this becomes hard and frozen as they reach 1,500 feet or so. Under the dead vegetation are concealed plates and bulbs of glassy green ice. Stumbles cannot always be avoided, even by the most expert. Those who have good boots with sharp nails, and are quick with their axes, will avoid falls. They now turn a shoulder and climb steeply upwards,

beside a sparkling burn. The stream-bed is here and there filled up with snow masses, beneath which the water runs in icy caverns. This snow gives good walking and convenient bridges ; it is in frost extremely tough and strong.

Two hours from the start they enter the corrie below the face for which they are making. They have here reached 2,000 feet, and the snow, till now intermittent, becomes continuous. The great precipices above are heavily draped with snow and ice. Any water-drainage areas are now enormous masses of green, blue, and black ice. Huge cornices run along the summit of the cliffs. Many hundreds of tons have fallen from these some time ago, and their remains, in shattered blocks, form long cones of avalanche debris at the foot of the larger gullies.

There is no risk from avalanches to-day : it is now hard frost, and the feeble sun of a Scottish April, which, it should be remembered, corresponds to about February in the Alps, hardly touches these north-east faces.

The leader points out the route proposed. It lies up a great gully, or couloir, about 1,500 feet in height, which cleaves the line of the crags. It looks almost vertical, but A knows that the general angle does not exceed 50°, though there are two difficult places, pitches in summer, of much greater angle. One of these is near the foot, the other about half-way up. There is, of course, also the summit cornice, but for the evasion of this A has a plan.

The party, therefore, cross the corrie towards the foot of the couloir. Here they come across a "snow-bog." The powdery snow driven from the cliffs and slopes by a gale has settled here, and has become covered, through the action of a subsequent thaw, with a crust of ice. This sometimes bears, sometimes does not ; making progress through such a "bog" is both exhausting and exasperating.

Fortunately the distance is not great, and they soon reach the debris tongue at the foot of the couloir and

J. R. Young.

ASCENDING HARD SNOW.

J. R. Young.

DESCENDING HARD SNOW.

proceed up it. At first steps can be kicked and all move at once. When it becomes too hard to kick, the leader slashes steps with the adze of the axe.

They halt for lunch on a snow ledge under the right wall of the gully mouth, and, this finished, now rope up in the order, A, B, D, C. In summer a pitch of about eighty feet exists here. This is now filled, up to the last ten feet, by a vast mass of steeply sloping *névé*. At its summit the *névé* does not quite reach the rocks of the pitch; there is a gap. The leader finds himself, after careful probing and testing of its strength, his rope well tended by B and D, standing on the tip of a long tongue of *névé*; beneath is a great black vacancy, its depth fathomless to sight.

After a good deal of work, the leader manages to find a place where, the rope well held by B and D, it is possible to lean over and get a hold on the opposite wall. He crosses and ascends, establishing himself in good snow some twenty feet higher. With the aid of the rope from above, the others have no serious difficulty except the last man, C, who finds the space seriously widened by the manœuvres of the three preceding him, and has to be hauled, when he at last makes up his mind to cross by jumping. There is now no further difficulty for a long way. The party kick steps in good snow at an angle of 45°, and mount rapidly for 600 feet. Though the ascent is easy, such an angle in such a place looks horribly steep to a novice. In even some Alpine narratives this angle is called "about 60°;" which shows at any rate that the writer was impressed by it. The slope gradually steepens to 50° below the second difficulty, and close up against it the snow lies for a few feet at an angle of 60°; above that appears the ice of the second difficulty.

At an angle of 50°, even on good snow, were there novices, timid, or uncertain members in the party, it would be advisable to proceed in rope's lengths. On this method the leader, who has an unusually long rope, cuts, kicks, or slashes small steps until he has

all the rope out. He then makes four good steps, and, driving in the axe and using it as a hitch, brings the others up in perfect security. The reason of the four steps is, that when B comes up, A can hand over the charge of the party to him, B can use A's ice-axe hole, while he himself again advances.

The method of driving an axe into hard snow is by taking the head in both hands, getting *above the axe*, and driving in the shaft with straight arms and the weight of the body, giving a slight turn to the shaft as the spike sinks in.

The second obstacle is a formidable one. The pitch here is mostly buried, but the upper part is bare. It has been a small water-slide. It is now an almost vertical mass of ribs, stalactites, and curtains of ice. This will cost an expert leader more than an hour of hard work to overcome, though it is not much more than twenty feet in height. The rest of the party arrange themselves in a shallow cave on the right side, and the hitch is made by laying the leader's rope over two axes driven almost up to the head in the good snow below the ice-fall.

When a hitch is wanted on snow, it is a common error to take a turn of the rope *round* a driven-in axe. This is a very bad mistake. If A were to fall off the ice-pitch, it is desired to stop him as gently as possible. No scope for gradual stoppage exists with a rope round an ice-axe. Three things may happen: the axe is pulled out, is broken, or A's ribs are. By laying the rope *over* a well-driven-in axe-shaft which is sloped slightly up-hill, the strain, however heavy, will not break the axe or pull it out, as it is mainly transferred to the snow. The rope also can be run out and the *sudden* strain or shock wholly prevented.

A now tackles the fall. Owing to the steepness, good toe-holds and pulling in hand-holds must be made. This is very exhausting work, as only one hand is of course available. After getting about ten feet up, A comes down again for a rest, and D has a try. He

soon has enough of it, as he tires much quicker than A: not that he is weaker, but his balance is less perfect, and the strain on his left arm is in consequence severe. Cramp threatens quickly. Coming down rather hurriedly, he slips from the last ice-step, but is easily fielded by A and B. A now resumes, and, breaking through a regular curtain of ice, obtains some splendid pigeon-hole steps which make also first-rate holds. He reaches good snow above, cuts some secure stands, and the others then come up quickly. The slope above the ice-fall was of 40°, it now again rises to nearly 50°, and some "bad" snow is encountered. This is a thin crust of icy stuff, covering several inches of soft snow, beneath which again is hard *névé*. It would be possible here to advance quickly by kicking pigeon-holes in the upper crust. In such a position as the party has now reached this would be a most rash and dangerous proceeding.

I have seen a crust of this description in a steep gully about sixty feet wide, break right across, and slip down several feet. Luckily it then stopped.

The correct way to go to work here, is to smash the crust with the head of the axe, scoop out the soft stuff with the adze, and cut steps in the underlying snow. This is slow, but it is safe; it is our party's method. They are now approaching the final difficulty, and again get on good snow. The leader is anxiously scanning the conditions ahead.

This last real difficulty, the cornice, though, as evidenced by the debris at the foot, considerably reduced of late, still shows a slightly overhanging wall, twenty-five feet high in line with the gully. This may be considered as impossible; the leader seeks to evade it. The walls of the gully are here very steep. They are plastered with ice and snow; moreover, all the holds have a disagreeable outward tilt. No way of escape offers here. In the right-hand corner, where the cornice sweeps round to meet the gully wall, its height falls to about ten feet, and it is not quite

vertical. Here is the weak point, and the party make for this.

Where the cornice steepens from the gully angle a miniature *bergschrund* appears. This is just wide enough for A to get in his left leg well past mid-thigh. He then beats, kicks, and cuts a sloping upward traverse to the corner. Arrived here, his rope is all out: so first B and then D get into the crack with their left legs and follow on. C remains well hitched in the gully. A's two immediate followers then pass their axes up to him. He proceeds to construct a staircase with their aid up the wall. A drives the axes into the *névé* almost up to the head, and mounts upon them, holding himself in and aiding the ascent with well-cut hand-holds in the tough cornice snow-ice. With some cutting, he is able to get his own axe-shaft driven in to the flat cornice top and when it is firm drags himself over the edge, and the gully is vanquished. The others have little difficulty in following. C, the last man, has the hardest work of the three. Held by the rope, he has to extract and pass up the " keys " of the ascent, the two ice-axes, and is then hauled up himself.

The party now find themselves on the top of a rock ridge, this slopes down slightly to a little gap, then rises more steeply to the final summit of the mountain.

The rock ridge is narrow, and steep on both sides. It is now everywhere, that it is not actually vertical, buried in ice and snow. Small cornices bend over, first on one side, then on the other. Sharp inch-wide arêtes of hard snow connect the little rock towers. Though really quite safe going, except in a high wind, such a place is exceedingly impressive, and is nervous work for the novice. Pace is necessarily much slower than in summer. The leader must often cut down the apex of an arête, or smash with heavy blows of the sideways-turned axe-head, the beautifully carved crest of a little cornice. If holds are wanted, they must be dug for and discovered under the concealing snow mantle. This kind of place is a good test of the real

J. R. Young.

A BRITISH CORNICE.

"Will it go?"

J. R. Young.

A BRITISH CORNICE.

"Gone!"

mountaineer. Good balance foot-work is far more important than any amount of muscular arm-power.

The ridge is short; the party soon break through the small incipient cross cornice that marks its junction with the main mountain mass. They walk up the hard, wind-swept, icy *névé*, to the stick which still marks the site of the buried cairn on the summit of the peak.

Here they are rewarded with views of snows no less beautiful and impressive than from many an Alpine summit, and in addition there is spread before them, a glorious vision of that majestic complement of mountains, the ocean.

They descend, as evening draws near, by an easier side, and on the way down may have glissades, both sitting and standing, of much better quality than any likely to be met with on Alpine ascents four months later.

SECTION III

ALPINE MOUNTAINEERING

CHAPTER VII

CENTRES; GUIDE-BOOKS; HOTELS; GUIDES; PORTERS; HUTS

This section deals with modern mountaineering as carried on in the Alps of central Europe. It is not proposed to give any personal narrative of particular ascents. In the second part an account of a climb will be given, which, though imaginary, is a kind of composite photograph comprehending all the features characteristic of Alpine peak-climbing.

Centres

In all probability the Alpine novice, whether with British or other experience or not, will pay his first visit to one of the three chief centres, Chamonix, Grindelwald, or Zermatt.

To this course he will most likely be drawn by his reading of old Alpine adventures, by the advice of friends who have already been there, or by the facility of access.

It is certainly the fact that these three centres are by far the best places for the novice who wishes, with guides, to be introduced into the very heart of the Alpine ice world—they are perhaps, nowadays, not so suited for learning real mountaineering.

There are, of course, innumerable other climbing centres. The Dolomites have a charm of their own. The Engadine can show fine ice scenery and some good peaks. Dauphiné is rugged and grand, and possesses splendid and difficult mountains, hardly perhaps suited

to the novice. The Italian side of the Alps is even finer than the French and Swiss. Nevertheless, the access to the heights is easiest at the first-named centres; they have greater hotel and hut facilities; they also possess the largest number of competent, experienced guides.

Guide-Books

Guide-books innumerable have been brought out for all the chief districts, and for most of the minor districts of the central European Alps. Some of the most useful of these will be found in the list of books at the end of this volume. A warning may here be given with regard to the times in some of these climbing guides. Climbing times, to be of much use, should be fair average times. Records may be dangerously misleading. Far more important factors than the strength or ability of a party, in their influence upon the speed of the ascent, are those of number in the party, and, above all, condition of the mountain. The same party of experts may take twice the number of hours to open the ascent, say of the Weisshorn, in June, that they did to climb it in the previous August. Mountaineering has no kind of resemblance to a flat race. If records are given in a climber's guide, it is safe to allow from 25 to 50 per cent. more time to make them probable times for an average party. Another warning may also be given with regard to those climbing guide-books, mainly continental, which give elaborate dotted diagrams of climbs. These, from exigencies of scale, are only very roughly accurate. Difficult places where straying is likeliest are not shown.

The would-be mountaineer's best guides should be the government maps, on a scale of not less than 1 in 50,000, the compass, the aneroid, and some half-plate photographs of his peak and its surroundings. It requires, of course, some little practice to read a map and photograph together correctly. Anyone who

aspires to lead a party in the Alps should certainly make himself an expert in this.

Hotels

These are innumerable, and of all grades, at most of the great mountain centres. Many are huge caravanserais, where the climbers are completely submerged in the torrents of touristdom which flood the Alpine valleys in the high Alpine season.

Some hotels have old climbing associations, and the novice will likely be attracted to these for sentiment's sake.

This is not an hotel guide, but there is one point about which a would-be climber may be doubtful; whether he should be a pensionnaire, or pay as he goes. This really depends upon whether he is an ex-centrist, or a centrist. There is no doubt that for the man who wishes, with guides, to enjoy as much luxury and comfort as possible, and at the same time ascend as many peaks as he can for the smallest expenditure, it decidedly pays to be a pensionnaire, or centrist. He enjoys the benefit of a much lower tariff. He receives more consideration in an often crowded hotel. He is free for a time from the baggage nuisance. His guides are at home and handy, he is not put to the expense of their maintenance. Family ties, ignorance of the language of the natives, and desire to avoid trouble, will induce many to follow the centrist plan. The man who always confines himself to this can never take high rank as a mountaineer.

Guides

The standard of mountaineering craft, if not of art, among the best guides, has undoubtedly risen of late years. At the same time there is as little doubt, that the average level reached by the general body has fallen.

The pioneer guides, who have been written of with respect, indeed with affection, by the men of high character and mental ability who enjoyed their services and comradeship, were naturally the pick of the most daring and enterprising men of their valleys.

Nowadays things tend to become more mechanical; character suffers. The enormous development of Alpine climbing, and the high pay, has attracted into the guiding profession many Alpine peasants who have no real calling for it. These men are steady, honest workmen, who may be trusted to carry out their contracts with punctuality and despatch. The A B C of their art is quite enough to enable them to handle the average Alpine tourist on standard routes well known to them, and under good conditions; they never learn any more. If anything unusual is asked of them they will refuse, or bungle it. To take such men to a new country is asking for annoyance and trouble, and getting it. These men never attempt to teach mountaineering, and to follow or imitate their methods would be extremely bad policy.

The advice is freely given to the novice that he should employ and study only first-rate guides. Unfortunately for the novice, the man who gives him that advice has usually prevented him from following it by engaging the guide himself. The best guides are usually booked up by the *cognoscenti*, often a year in advance. The novice will usually have to put up with the second-clsss man, by far the most numerous.

Of the third-class guides it is not necessary to say much. They are not a numerous body, but, in spite of the examinations, the certificates, and the "books," they still manage to exist. Natural stupidity, illness, accident, or old age may put a man in the third-class category. Perhaps he owes his deficiencies to a too free use of the brandy-flask, though this defect is more commonly found among the *old* porters. Brandy is not necessary for an Alpine expedition. A traveller, in engaging guides, should let it be clearly known that

not only will he refuse to pay for any brandy, but he will not allow a bottle to be carried. If a guide says he must have brandy, refuse to engage him. If the man really needs it he is down on his last reserves, and is not safe for a long expedition.

The traveller should himself carry a flask of good strong cognac, as a reserve. He may allow the guides a sip or two if he thinks the occasion requires it, but the less spirits drunk during a climb the better. The guides' usual drink is the red wine of the country; a bottle apiece of that will do them no harm.[1] The only objection against it is its weight.

There is undoubtedly a difficulty for the novice climber in the Alps in obtaining the services of a good guide. The porter at his hotel will usually be able to furnish someone. This man may not necessarily be bad; it is obvious, however, that other influences besides merit may have led to his name being given. Two hints may be given as to guides to avoid. If his book shows that he is mainly a one-peak man, on no account have anything to do with him unless for that peak. Firmly decline all offers from the guide who touts for employment at stations *en route* for Alpine resorts, and expresses his willingness to take you anywhere before he knows of what you are capable.

As there is a difficulty, for a novice, in getting in touch with a really good man, so is there difficulty for a first-rate young guide in getting his name known. It is as well to take particular note of the Christian name, and *nickname*, of a smart young guide you have been told of. Cases have occurred, owing to so many guides in the various centres having similar names, of annoyance to the travellers, and serious loss of reputation suffered by a really good guide, through the delinquencies of an inferior man of similar name. It would appear a sensible plan for guides to advertise in the technical journals, as do gamekeepers and yachtsmen. An even better plan might be for the

[1] See Chapter XIV.

guides to place themselves in the hands of an agent in the various capitals whence come their clientele. The guides would pay nothing, but would give particulars of themselves, and send their books annually to the agent to copy their list of expeditions.

Thus a traveller would be able to secure before starting a suitable guide in any district. The prices of all the usual ascents are all now fixed by tariff. For any special climb, mutual agreement could be come to. If the traveller, or the guide, objects that hereby he is engaging himself with a man of whom he knows nothing personally, he could have a clause inserted in his agreement allowing for a mutual break after a week or a fortnight.

It would really seem better, in any case, for an agreement with a guide, to be in the form of a signed letter. It is notorious how easy it is for misunderstandings to arise over words spoken a month or so previously.

With regard to the number of guides to be taken, this so varies with the numbers, age, and capabilities of the party that no general rule can be laid down. There are in several Alpine centres special rules on the subject.

Doubtless many parties are often over-guided. Under-guiding, due to ill-judged economy on the part of the traveller, possibly to jealousy or greed on the part of a guide, is more likely to occur. A few rough generalities as regards numbers may be given.

For a first-class expedition, a novice must take two guides, or at least a guide and a porter. Two travellers can go with two guides and one porter, and, if they choose to do some carrying, can omit the porter. If one of them is a climber of some experience they can manage with one guide and porter, and, if doing most of the carrying, can omit the porter. When a single guide goes with three or four amateurs, the climb is either of a very minor character, or the guide is there simply in the restricted sense, and is not in command of the party.

As to who is in command of the party : as in war, there must never be the slightest doubt about this. More disasters can be traced to the absence of a clear understanding on this point than to any other cause. Old, experienced mountaineers, who take a young guide, may be trusted to make their own rules. It is obviously unfair to place the responsibility of decision, say, of ordering a guide to proceed up a difficult place, evidently close to the limit of his powers, or of pushing on in bad or doubtful weather, upon the employing novice. He should decline this. He, however, where failure to make the ascent, due to illness, or unfitness on his part, is likely, ought in that case to inform the guides that they will not be pecuniary sufferers through his default, otherwise they may be tempted to push on.

Besides doing the work of guiding, the guides will also look after the traveller's boots, perhaps mend his clothes. They will cook, wait, and clean up in the huts not provided with a guardian, and generally act as the employer's servant. I have, however, seen the rôles reversed in the case of a certain famous guide, since deceased, and a continental lady climber.

Guides' Books, etc.—Almost every mountain guide in the chief resorts is now a member of a trade union. Tariffs are all fixed and printed, and can be obtained in the hotels, at the Bureau des Guides in the village, or in the guides' books. Every guide is supposed to carry a book containing his certificate and description, and the tariff of the chief ascents. The guides have these books and certificates issued to them after their passing an examination as regards general knowledge and technical fitness. This examination, of varying strictness, is conducted by the authorities competent to do so in the different localities ; usually, the national Alpine Clubs endeavour to have control of this.

Most guides nowadays are comparatively well-educated men. Some Swiss guides can speak three, or even four languages, in addition to their own patois.

The traveller is supposed to write in the guide's book an unbiassed opinion of the climb he has just done, and of the guide's conduct of it. As the great majority of Alpine travellers have little or no knowledge of mountaineering, their opinion on the subject is naturally of very slight value. They might easily do less than justice to a really good man who was less suave and plausible than another.

The list of climbs done is, however, a good test, and if it shows a number of peaks and passes outside his native valley, the man is probably a mountaineer, and not merely a workman. Guiding is, of course, not a whole-time occupation; many guides are peasant proprietors, others are tradesmen. Some go to work in the great cities during the winter. They are not always improved in manners, or character, by this migration.

The great development of winter sports, especially ski-ing, of late years has virtually doubled the earnings and employment of the younger guides.

Time-work and Piece-work.—The list of climbs in the guides' books are tariffed at piece-work rates. This is for those tourists and climbers who may want to make one or two standard climbs, such as Mont Blanc, or the Matterhorn. It is a much better plan, and also cheaper if the weather is favourable, and the traveller a good walker, to engage the guide on time-work. He is then paid a flat rate per day, irrespective of what is done, or he may be paid something extra for a big expedition, receiving reduced or half-rate pay for off-days, a firm engagement being made for a week, fortnight, month, or longer.

During the month of August a good guide can generally earn, if the weather is at all favourable, a much larger amount on piece-work than he can on time, and this fact should be remembered by those who seek to monopolise his services then. At other times the rates are easier.

The piece-work system is not a good one for those

who wish to enjoy and learn mountaineering. The guides naturally want to finish the climb with the smallest possible delay: it may mean their losing another job if they are not back at the starting centre early. The traveller is therefore made to get up in the middle of the night. He is hustled to the top of his peak, mainly in the dark. He is not given a moment to admire the views, or the dawn. He is only permitted the briefest space at the top, and is rattled down again at the utmost of his powers, arriving at his hotel early in the afternoon in a state of partial or total collapse.

If the tourist is young, strong, and active, and has gone reasonably well, his piece-work guides will flatter him by saying he is a "chamois" and has "beaten the record." It is possible he may be so ignorant as to believe, even to publish, the last as a fact. In a good season the system is also bad for the guide, as tending to overstrain. This has undoubtedly led to disaster, especially when the brandy "whip" has been too freely resorted to.

Porters

The Alpine porter usually begins his career as a lad under some relative, father, uncle, or elder brother, who is a guide. After a number of years, but not usually before he is twenty-four years of age, the porter can sit for his guide's examination, and, if at all intelligent, is tolerably sure of passing. Some porters are as good, or better, climbers than the bulk of the guides; but, as a rule, the loads they have to carry are apt to obscure their climbing merits. Their demerit is, of course, want of judgment, owing to lack of experience. They seldom, however, get the opportunity of an independent lead. The porter's pay is about half of that of a guide. There are, in places, an older class of porter to be met with; these, as a rule, should be avoided, if the proposed expedition is to be one of any considerable difficulty.

Huts, Chalets, "Gîtes," Tents, Bivouacs

In the early days of Alpine climbing the party generally spent the night in a chalet built for hay storage on the highest pastures. If none of these existed high enough, then the *gîtes* of chamois-hunters or shepherds were utilised. These were holes under boulders, or recesses under overhanging rocks near the limit of vegetation. Bivouacs in the open were sometimes made. Tents seem rarely to have been employed.

At the present day, huts are so numerous above every Alpine centre that they are almost always used when the climb is not done direct from an hotel. The other starting-places will be dealt with under "Exploration." [1]

Huts may vary in size and character from a large two-storied building with separate bedrooms, wash-hand basins, and the usual appurtenances of a small rough hotel, to a wooden box-like structure, with merely a stove, a table, a bench, and a bunk containing a little straw. Every gradation between is found. The larger huts are nowadays really hotels, and run on the same lines. A common intermediate kind consists of three or four rooms, and is in charge of a caretaker. For the occupancy, or rather for a very small share of this, a moderate fee is paid. Generally in this kind of hut some tinned provisions, and also wine, can be got. The other class of huts are smaller, usually of one room only; sometimes a ladies' part is partitioned, or curtained off. They are either locked, in which case the key must be got from its guardian, usually the nearest hotel-keeper in the valley below, or else they are open. For the use of the last two kinds of hut no charge is made.

There has been a considerable amount of misconception, both in their own countries and abroad, as

[1] Chapter XV.

Harold Raeburn.

A HUT INTERIOR.
The Promontoire on the Meisje.

regards, say, the Swiss huts. Nearly all these belong to the Swiss Alpine Club. They are, naturally, built and equipped, provided with paths of access, and kept up with the Club's own money, for the purpose of providing accommodation, and facilitating access to the Alpine peaks, to the club members and their guests. An unauthorised stranger, or party of foreigners, has no *right* whatever to occupy them. The Club, however, readily accords a welcome to members of foreign Alpine clubs, who grant them similar privileges. Undue advantage is often taken of the Swiss Alpine Club's huts by parties, usually of non-climbers, to the great discomfort and annoyance of the Club's members and guests.

These abuses have led to many discussions in the Club, and stringent rules have had to be drawn up to abate the nuisance.

Unfortunately it is much easier to draw up rules than to enforce them in these remote places.

For British climbers' own self-respect, club membership is quite necessary. No elaborate qualifications are required for this. A proposal by a member, and the payment of the subscription, are sufficient. Guided climbers are really in the huts as guests of their guides in many cases.

It is a duty lying upon the party of climbers leaving one of these huts last, to see that it is left in rather better order than when entered. As a rule, this will not be found difficult.

Mr. Dent, writing in *Mountaineering* in 1892, says: "For those who are not afraid of solitude there is a great charm to be found in a stay at one of these huts." Times have altered. Those who go in August nowadays will find this rather sarcastic; the "solitude" is of much the same nature as that enjoyed by the sardine in its tin.

CHAPTER VIII

AN ALPINE EXPEDITION

Two friends, C and B, have resolved upon a season in the Alps. Of these, C is an experienced home climber, who has also had a couple of seasons mountaineering with guides. B is an excellent man on homeland hills and rocks, but has not, as yet, had any climbing on permanent snows.

A had somewhat suffered, on his earlier visits, from rushing his peaks with a piece-work guide. The friends' arrangements allow them four or five days to get into condition, and for C to take B to some easy, naked glacier, and give him some practice in step-cutting, handling his axe generally, and moving on short, safe ice-slopes. C has, as yet, insufficient experience to justify him in leading a party on the heights. He knows an able guide, A, who, having experience of C's capacity, is willing to go alone with him and his friend.

At the end of the training period the friends are joined by A. An ascent of a great peak is resolved upon. This lies too far off to be done in one day: a night must be spent in a small unlocked hut from four to four and a half hours' walking (5,000 feet) above the hotel.

A proposes that the party start after lunch on the following day. C, however, insists upon an early start, soon after breakfast. C's plan is much the best. A's would mean a grilling walk, after a probably hearty lunch. No time or light would be left, after arrival at the hut, for drying up, photography, or prospecting the route for the morning. The party might easily

find the hut stove occupied, and have their last meal, which ought to be taken early, thrown back, to the serious curtailment of their short night's repose and sleep.

It is, therefore, only nine o'clock next morning when they start. In order to save the party's energies for the strenuous day to follow, they engage a porter as far as the hut. This also allows of a good stock of wood being taken.

The hut, a small unlocked one, is placed on some rocks on the left, or far bank, of a naked glacier which flows down between their starting-point and the hut.

The way at first lies through small fields under cultivation, then over meadows. It then slopes up more steeply, and zig-zags through a large forest of pines. These get thinner as the party mount, and presently they emerge on the bare upper pastures above the tree-limit. They here make a short halt, in order to collect dead wood for the hut stove.

During the ascent A has seemed to B to go very slowly, but C will not allow him to be hurried. For the loaded porter's sake C has also called a halt every hour for five minutes. Presently the hut comes in sight, standing on a rocky knoll on the far side of the glacier. B suggests they will reach it in ten minutes, but A, with a grin, says, "One hour," and he is right. It is at first very difficult for the inhabitants of the moist and misty isles of Britain to estimate distances correctly in the thin, dry, transparent air of glacial heights. B might console himself with the knowledge that A, on his first visit to British hills, would make as wild an estimate, but in the reverse direction. The party now comes to a steepish descent leading to the glacier. There is a kind of track, however, and they do not rope. At its foot is a "bad place" to cross, a stretch of unstable moraine. C here puts on old leather gloves, and advises that B should do the same. This is a wise precaution. Moraine blocks often lie, bedded in loose grit, on hard ice concealed below. It

is sometimes impossible for even the most active and vigilant mountaineer to avoid a stumble. Prompt use of the ice-axe or of the hands will generally prevent a complete fall. Moraine debris, however, has often edges like knives : the gloves prevent probable damage to the skin. The glacier is now gained. It is here almost flat, but seamed with many transverse crevasses. The surface is rather like coarse sugar or salt ; the nails bite perfectly. It is quite easy to jump the narrower crevasses, and to walk along the strait ice-slices connecting the larger.

Near the far side the ice rises in considerable waves. Steps are, however, already cut up and down the slopes, and no delay is caused. Passing through another lateral moraine, the climbers ascend a rocky step. This is steep, but steps have been cut in places, and iron bars inserted, to which steel cables are attached : the loaded porter finds these necessary.

At the top they gain the hut. The guide unfastens the door. The porter throws down his load, and, after they have all had a meal, the porter says " Au revoir," or " Auf wiedersehen," and departs.

C and B change under-clothes and then stroll, with the camera, up a neighbouring rocky point, to bask in the sun, and to make the pictures and route studies for which neither light nor time will be available in the morning.

The guide, after putting out most of the blankets to air, coils himself in the remainder and indulges in a good nap.

As the sun gets low the air becomes chilly. B and C return to the hut, to find A busy over the stove preparing the evening meal, and another party, a guideless one of four, awaiting their turn. They finish supper just in time to see day passing in the gorgeous and exquisite colours of the after-glow.

It is too cold to remain long outside, and soon preparations for next morning and bed are under way.

The afternoon meal at the hut was mainly founded on tea, bread and butter and jam, or cake.

It is better to avoid tea or coffee at the evening meal; a bottle of red wine, mulled with sugar, is a more restful drink.

The meal is fairly substantial: soup; pea-flour and meat extract, to which the guide adds some of his favourite grated cheese, meat; some steak or chicken reheated; tinned articles are a poor substitute for the fresh. The dessert may be of tinned fruits if the porterage was sufficient.

It is highly advantageous to list and check all articles wanted, and to lay everything out ready for the morning, to get out the two lanterns to be used, and insert their candles.

A had suggested 3.30 a.m. as early enough for a start. He now whispers that they will start at 3, as he has heard the amateurs talking of the former time. C, therefore, winds up his alarm-watch, and sets it to go off at 2 a.m. An alarm-watch is now a most neat, light, and reliable article; no climbing party should be without one. Some people pride themselves on being able to waken when they please. I have observed, all the same, that an alarm-watch can sometimes catch them napping. For less gifted folks, its possession tends to the easy conscience conducive to slumber. At 8 p.m. all are snugly rolled in the blankets, lights are out, and conversation ceases. The older hands go to sleep. Sleep is at first rather difficult for the novice. The novelty of the surroundings, the subtle stimulus of the slightly rarefied air of 10,000 feet, thoughts of the climb of the morning—all tend to an excited mind not favourable to repose. B does drop off at last; he thinks it has been only for a few minutes, when the shrill, insistent voice of the alarm-watch proclaims that is is 2 a.m.

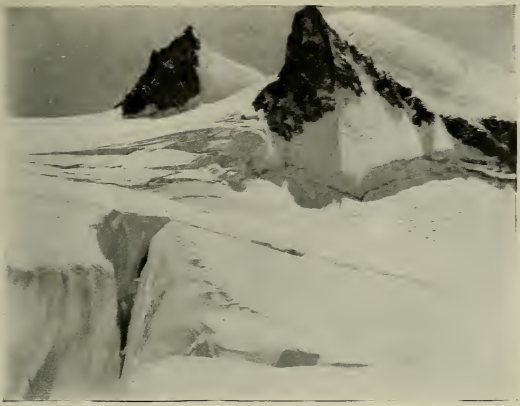
C and B do not rise for twenty minutes, when A comes and tells them breakfast is ready. It is an excellent one: bacon and eggs, tea, or coffee made

over-night, bread and butter, and jam. Not much dressing, and no shaving or washing, having to be done—it is a great mistake to wash or shave before a climb—B and C are soon personally ready. It is surprising, however, what a lot of time is wanted for final arrangements. Perhaps a sack requires turning out, to make certain nothing has been forgotten. Perhaps the boots were not dubbined over-night. It is never safe to allow less than one hour for starting, for a party of two. A good rule is to allow five minutes extra for everyone over that.

The party start at 3.5 a.m. exactly. They do not rope, but A and C light lanterns and B walks between. Descending the rocks where the cables are fixed, and passing through the left lateral moraine, they reach the ice. Turning right, or south, they walk up the glacier for a mile. Dawn has come as they reach a part of the glacier where snow begins to lie in the hollows. As this snow usually conceals crevasses, the party halt to rope up, and lanterns are also extinguished and stowed away. They use an 80-foot (25-metre) rope, and C also carries an 80-foot length of Alpine line, weighing 2 lb.

The foot of their first difficulty, the ice-fall, is gained just as the marvellous glows of last evening are reborn on the circling ice-peaks above.

An ice-fall is a beautiful and impressive sight. The glacier is here pouring over a rugged drop in its bed, and the ice is torn and shattered in all directions. At first in great parallel waves with chasms between, these are lower cut across transversely by cracks, clefts, and gaps, forming masses more or less rectangular—the true *sérac*. Lower still these *séracs* become wasted into pinnacles and fretted towers of ice, often overhanging. The cracks and chasms in the lower part of the ice-fall are often choked up by fallen masses of *sérac*, and old winter or avalanche snow. At the foot of the fall, as the angle eases off, the ice gradually smoothens out just like a river, and resumes its placider course.



Eric Greenwood.

CREVASSE, GÉANT GLACIER.

Eric Greenwood.

WORKING THROUGH AN ICE-FALL.

To B the whole place looks hopeless confusion, and quite impossible to pass ; but A, who knows the general direction of the best passage, leads the party in that direction. Difficult ice-falls are now rarely attacked in the Alps. Routes are usually devised to avoid them. . Easy ice-falls are still traversed, especially on the routes to cols.

An example of an easy ice-fall, which is often traversed, is that of the Géant Glacier, above the Mer de Glace. The next glacier to the east, the Argentière, gives an example of a difficult ice-fall which is avoided.

The party enters the ice maze, A always keeping before his mental eye a general picture of the whole fall, zig-zagging about, pressing the attack where the icy defences are weakest, but not allowing himself to be tempted by an easy opening into a part of the ice-fall which he knows to be impossible.

They come once or twice to an impasse, and are forced to retrace their steps a short distance, but are, on the whole, working pretty steadily through. The best routes generally exist over the debris and on the masses of old snow filling the larger clefts. A good many steps have to be cut, B and C have opportunities of cutting and enlarging steps for themselves. Occasionally actual tunnels must be crawled through, and the party several times pass under the leaning pinnacles of towering *séracs*. The day is young ; the sun is as yet only gilding the high crests. Frost reigns, and the risk of anything falling is very slight.

Old Alpine travellers used to relate how the guides, in passing close to a place where possible danger existed from over-threatening *séracs*, would solemnly insist on not a word being spoken, lest the reverberations might bring down upon their heads one of the impending masses.

For my part, I think the material explanation they gave for the guides' fear was an incorrect one. They failed to see into the men's superstitious fear. The guides' underlying dread was of the anger of the evil

spirits that they still more than half believed to lurk in all the waste places of the mountains, and who resented, sometimes with deadly effect, the intrusion of mortal men.

At length the party win through the fall, and emerge upon the flatter but still crevassed glacier above.

Now it is full day, and the sun begins to shine upon the upper snows with power. The party halts to put on goggles. Before doing so the opportunity is taken of covering that part of their faces devoid of the natural protective covering of the male with a well-spread coating of "Pomade Séchéhaye."

The crevasses are here mostly covered, the party keep twenty feet apart, carrying the loose rope in a coil in their left hand, and letting none drag. It does not always follow that, because A has sounded and safely stepped upon a crevasse covering, that B will certainly be all right if he uses his exact footsteps. He may be a stone heavier than A; he may walk in a much clumsier manner. He should always *expect* to go through. He will then have usually the pleasant surprise of not doing so.

At this time and place there is really very little risk of anyone breaking through, and in pioneer days few guides would have troubled to rope at all. It is best, however, to put on the rope. The very fact of doing so keeps the inexpert, and novices, in mind of the possible risk. They watch out and do not fall in. Nothing seemed commoner in old days than tumbling into a crevasse; now, this rarely happens in summer.

After about another half a mile has been covered, the glacier merges in the upper *névés*. A now turns to the right, north-west, and makes for a steep slope leading up to a rock ridge, the north-east, which rises steeply above to the summit of their peak.

The lower part of this slope is of snow; towards the summit the greyish colour and glistening appearance, betray the presence of ice. At the foot of the snow-slope, just where it eases into the glacier, runs a long

chasm in the ice, the *bergschrund*, *randkluft*, or *rimaye*. It is mostly open, and of great depth, forming an impregnable moat defending access to the heights. A slight concavity in the slope above has, however, directed the sliding masses of spring avalanche snow. These have poured down filling the *schrund* in the line of their fall. Summer, and the heated rocks, have melted the bulk of the fallen snow; but a hardened crust still exists, forming a bridge spanning the chasm.

A leads the party to the bridge. It is, on testing, thin, but strong. The party, nevertheless, crawl up it on all fours, in turn, distributing their weight still further by using the axes laid flat, in order to damage it as little as possible for the return. When clear of the bridge, A slashes steps rapidly in good snow for several hundred feet. The snow then begins to thin out, and, as the angle rises from 45°, the angle of the snow-slope, to 50°, it turns to ice. While this ice is not at all "black" ice—it still contains far too much air for that—it is nevertheless real ice, and not *névé*. Steps must be cut by the pick. A does this in zigzags. Had the distance to the rocks been less, and the angle steeper, straight up would have been quicker.

Some continental climbers have maintained that it is better to cut steps straight up. There are a number of arguments in favour of this method. Far fewer steps are required, and it is also easier for a higher climber to safeguard and assist a follower who stands in steps directly below him. Against this may be put the inconvenience of the ice-chips, or snow, falling on the lower climbers; but this is of no great moment if the party keep close together.

There are, however, other reasons in favour of the zigzag method, and, after having experimented with every possible kind of ice-step, I consider that, as a general rule, zigzags should be adopted on ice.

(1) It is very much easier to cut good steps in ice, in zigzag. Much of the swing is lost when cutting

straight up; the steps themselves must be deeper, and even then do not give so good a hold.

(2) It is not nearly so tiring to stand or walk in the zigzag steps; one can do this for hours. On the ladder ice-steps, unless very deeply cut, cramp is liable to come on.

(3) The "moral" effect upon the novice is bad on the ladder system; his feet being partly in the air, he has a tendency to try to get a hold on the ice in front of him, thus to lean forward, and abandon the safe attitude, the upright.

On short, steep ice-walls, where the angle is over 60°, and hand-holds have to be cut, then the ladder method is, of course, the best. On snow the mode is of less importance; but even here, as on steep grass slopes or easy rocks, zigzags generally pay best.

Had B been timid, weak, or with bad balance—he has shown A that he was none of these—it would have been better, assuming that B was taken on such a place at all, for the order to have been A, C, B.

C could in that case have watched over B, while A devoted undivided attention to the steps. It is not very difficult, and the steeper it is—up to 60°, at any rate—the easier it is, to stop a man who slips from ice-steps below one. It is almost impossible to stop anyone who falls from even a little way above. It follows from this, that no one except an expert ice-man should ever be allowed to lead up, or follow down, a roped party on a steep ice-slope.

Changing leaders on a steep ice-slope has been sometimes written of, but I think rarely done. I think the only case where this would be safe, and pay, is where a traveller who cannot cut steps is conducted by two first-rate guides of equal step-cutting ability. Probably, in most of the noted cases, the slope was really only hard snow, and not steep. Changing is best done on a rock island, or patch of snow, if the slope is of ice.

On our typical climb no changing is done; neither C nor B are expert ice-men. A works away steadily,

and, after an hour's hard work, reaches the rocks of the north-east arête for which the party has been steering.

None are sorry, after the heavy strain of an hour on an ice-slope at an angle of 50°, to enjoy a short rest on sun-warmed rocks with glorious views on both sides.

They then follow the ridge; the climbing is varied and interesting, without being very difficult.

Sometimes, in rounding gendarmes, A will get out of sight of B. The latter then takes a hitch, and waits for instructions. He must not allow his curiosity as to how A is getting on, to tempt him into a position where he cannot secure the rope. C may sometimes come close to, back up and secure B.

Presently they arrive at the foot of a great gendarme. This is cleft by a chimney about sixty feet high, finishing in slabs. Down it hangs a somewhat bleached-looking rope. A avoids this, and B, coming off the rope, A climbs up some very steep and difficult rocks on the left, looking up, of the chimney. He tells B to come up that way, but first to test the rope. B does so, and it bears his weight all right. C, however, is not satisfied, so both tail on and give the rope a good jerk. It at once parts where the iron piton to which it is attached above has rusted it.

The question of the roping of peaks is a very vexed one; it belongs, perhaps, more to the ethics of mountaineering than to the technics. It will be dealt with under that heading.[1]

A's route was very difficult; he had to leave both his axe and sack below. Everything must now be brought up separately. C, therefore, first sends up the ice-axes. This he does safely by bundling them together and putting them on the rope with two clove-hitches round the shafts, near the heads and spikes.

To guide them on their way up, and prevent them from catching in any projecting rocks, he bends on the light line below the parcel, with a bowline, or a sheet-

[1] See Chapter XI.

bend. A basket of eggs can be hoisted safely in this manner, if the A and C of the party are careful about working together, and the rocks are nearly or quite vertical. The sacks are now sent up, next B climbs, and the rope is finally lowered for C. He manages without any actual hauling, but is not sorry to have the moral aid and comfort of a rope held in able and powerful hands above. It may be thought that it would save time here for C to climb, carrying the axes, taking assistance from the rope. Usually it will be found preferable to work in the manner described. It is not an easy or comfortable business climbing steep rocks burdened with a bundle of restless, inquisitive axes, which will insist on sticking their long noses into places they have no call to : if C does bring them up, let us hope that A and B will have the decency to praise him for his neatness and despatch, even though this savours of diplomacy, and not of truth.

The far side of the so-called gendarme is an almost level snow ridge. Like most gendarmes on an ascending ridge, it is really a step. The ridge beyond is of ice covered with snow. It is, while very steep on the north-west side, composed on the south-east of a huge cornice impending over an almost vertical-looking slope, of mixed rock, ice, and snow.

The party have a good view of this side, and can see pretty clearly how much and where the cornice projects. Great masses jut out here and there, with overhangs in places of twenty feet, and obviously weighing many hundreds of tons. The climbers proceed along it at the full intervals of the rope, and well down the slope on their right, or north-west, side.

Where the snow is too hard to kick or slash steps A must cut them. He probes with the axe, and endeavours always to have two men, at least, below the line of possible fracture.

The probable line of fracture is often to be known by incipient cracks, which may again be filled by softer snow. The terrors of the cornice bulk largely in

Eric Greenwood.

THE ROTHHORN. TESTING A CORNICE.

Eric Greenwood.

BERGSCHRUND. GRAND PARADIS.

Alpine story, and many wholesale disasters have happened to parties recklessly, or ignorantly, venturing too far up on them. There is, however, no excuse for guides or climbers who do this. Cornices are the very commonest of Alpine phenomena. They are to be expected on the summit of every exposed ridge, at the top of every steep couloir or gully, and also at the precipitous edge of broad, rounded ridges and plateaux.

No party should simultaneously approach the edge of such places. The leader, well secured from behind, should always go forward to prospect.

Some marvellous escapes are recounted, owing to the quickness and presence of mind of a guide, who has cast himself down the opposite slope to that of the falling cornice, and thus brought up and anchored the others, who were falling with it.

A friend of mine has told me of a wonderful escape experienced while making the ascent of a very heavily corniced north-east ridge. At one moment he was making his way along a very steep snow-slope which towered above, shutting out all view on that side. Next instant he was balancing himself on an arête of ice, on one foot, the other poised over vacancy, while a vast panorama of clouds, snow-peaks, glaciers, and wooded valleys was spread before his gaze.

In this case the leading guide was at fault; he had gone too high up on the cornice, and his weight proved the last straw. He just managed to scramble off the cornice as the ponderous mass fell.

Sometimes there is no cornice, the opposing snow-slopes meet in an edge only an inch or so wide. This, though really safer than the cornice, is often very trying to the novice.

In old narratives, parties seem generally to have crossed such places *à cheval*. This is slow, tiring, wet, and undignified. If the ridge is of snow it is, for mountaineers, better and quicker to walk. The leader, in this case, is let out to the full length of the rope, if thus he can reach a place of security. He may either

flatten down the edge with the axe, or make steps on either side. If the ridge is of really hard ice, where steps would cost a deal of hard labour to cut, it may pay to straddle it and hoist oneself along with the hands. Such places are rare. Our party is not reduced to that here, as there is enough good snow, kept so by a cool northerly air, to make step-kicking safe and easy. The position is new to B, and he does not quite like it; but he sees A walking with ease and confidence, he knows his friend C is watching the rope carefully behind him, he makes up his mind he will not be giddy, and he is not.

At the end of the sharp snow arête the ridge again shoots up into the steep rocks of the final peak. There is a certain amount of ice on these high rocks, great care, and some cutting, is required. At the top of an ice-chimney, where B had begun to think that A was cutting steps too small and far apart for a last man's safe descent, there is found a strong piton of iron driven into the rock. The chimney proves the last difficulty. Above it they walk up an easily sloping arête of snow and rock to the summit cairn.

Here they spend an hour in lunching, in photography, in admiration of the wide views and exquisitely beautiful scenery of their surroundings, and in well-earned repose in the warmth to be found a few feet down on the south side. The guide probably, after his meal, drink, and pipe, stretches himself out and goes to sleep at once. He has had some long expeditions during the past week. If he did not possess the faculty of sleeping at once and anywhere, he would not be able to keep in the good condition he now is.

After the summit hour, which passes only too quickly, C wakes up the guide; they start downward, re-roped again, in the reverse order to the ascent. At the top of the ice-chimney A lays the rope over the piton—he does not *belay* it—as C and B descend. He is now carrying the spare line. When his turn comes he lays the middle of this over the piton and walks

Eric Greenwood.

SUMMIT OF THE DISGRAZIA.

down the top forty feet, the worst part, with perfect ease and safety, holding the line in his hands.

Whatever may be urged against the roping of peaks, there can be nothing to say against using a piton to safeguard the party on the descent.

Sometimes rope-rings are left at difficult places.

Pitons.

These avoid risk of the rope jamming over natural hitches. They ought, of course, to be most carefully examined and tested before trusted. Like the fixed rope in our expedition, they may be rotten. Nothing is more irritating and tiring, for a last man, than to have to swing up a steep place to release a rope which has jammed. Therefore natural pitons and hitches require most careful testing. If a hitched rope will not come off when the last man is down, and it is too difficult and exhausting to re-ascend the pitch, then it should be cut as far up as possible. It is as well for guideless parties to remember, that if they see a loose end of rope hanging at the top of a difficulty, it probably points to a wrong route, or one only used on the descent.

When a natural piton or rock-spike is used for a descent, particular care must be taken for the first part: once the weight is well below, a very slight projection will hold the rope securely. Sometimes, as, for instance, on the descent of the south side of the gendarme on the Grépon, it is necessary, from the nature of the hitch, for the last man to grasp the two ends of the rope separately in each hand and to move down very carefully and evenly, to prevent the rope rolling off. The slipping of a rope from a hitch, when the climber was retreating from a difficult position, was the cause of the death of the famous Austrian mountain-

eer, Dr. Emil Zsigmondy, on the south wall of the Meije.

Our party is soon all down, and, with the aid of the steps already kicked or cut, pass along the ice arêtes and skirt the cornices in much less time than they occupied on the ascent. At the "broken rope" chimney, after letting down C and B separately, A ties the two ropes together with a fisherman's bend—it should be noted that a reef-knot, with ropes of different thicknesses, is not a holding knot—then comes down the whole sixty feet safely and easily himself.

On the way down the rock arêtes, C does the path-finding quickly and well. It is seldom necessary for A to come forward and halt the party while he points it out. The necessity of an amateur leading down, with another amateur above him, is what constitutes the real objection of a guide to conduct two amateurs. He can do so with no loss of time on the ascent, but, unless the amateur is experienced, or the ascent stereotyped and well "blazed," much time is certain to be lost on the descent. An exaggerated idea of the relative difficulty and time involved in a descent on somewhat complicated rock-peaks used to prevail, and to a certain extent does so still. This idea is to be found in the Alpine narratives of descents with parties consisting of two guides and two amateurs, in which the amateur has led down. In reality, for the skilled mountaineer, the descent is both easier and quicker, and much safer also if he uses a rope.

The descent of the ice-slope is somewhat trying, and is conducted with the greatest care. The steps are yet in good condition; C has only an occasional scrape to make. The time occupied is, of course, a mere fraction of that needed in the morning. The party descend in less than ten minutes what cost an hour's hard labour to ascend. When they reach the snow, however, it is a little inclined to slide where they walked easily in the morning, and C has a good

Harold Raeburn.

MIST ON A GLACIER.
"Is it lifting?"

Harold Raeburn.

ON THE GLACIER DE LA MEIJE. STEEP ICE.

half-hour's heavy work before it is considered safe for all the party to again move together.

As they approach the bridge across the *schrund*, one or two tiny snow-avalanches slide down the hollow above and sweep across it. A decides it is better not to risk crossing in that line. He has, on the way up, noted an alternative route of descent, in case the bridge had weakened or fallen in. The party "'bout ship," and steer 100 yards north-east along above the *schrund*. Here a slight ice-promontory hangs right over the chasm and overlaps its lower lip. They establish themselves on this as near the edge as possible. C is then put on with a bowline on a bight and lowered over. He lands safely, and shouts up that it is only ten feet, with a good snow landing. B, who is a good vaulter, volunteers to come down last and jump it. Two axes are now lowered to C. The third is inserted in a convenient crack, and the spare cord looped over it. A can then come down easily in a single loop, B taking half his weight off him. B then sends down the last axe, comes as near the edge as possible, and prepares to jump. The others stand clear, and prepare to field him should he, on alighting, slither down the snow-slope or tumble back into the *schrund*. B does neither: he drops lightly and neatly in the soft snow, and is not in the least shaken.

A short standing glissade is now possible, and is indulged in for practice. Roped glissading is, however, very much of an experts' game, and is seldom satisfactory. All are jerked off their feet in turn, even the guide.

The descent over the upper glacier, and through the ice-fall, needs more care and circumspection than in the morning. One or other puts a foot through the softened snow covering a narrow crevasse. It is rare, however, that putting a foot through goes any farther. Had the crust been really weak, and the crack of any width, probably both feet would have gone through at once. A swinging forward of the other foot, and a slight

pull on the rope, will usually prevent any but a momentary check on the party's steady progress.

They delay as little as possible when passing below the over-hanging *séracs*, and are able to avoid the worst of these by taking a slightly different route, involving a jump down of about six feet over a crevasse, quite impossible on the ascent.

Through the fall, they still keep on the rope until the moraine is reached, when it is taken off gladly by all and carefully coiled. The climb has gone well. No unforeseen delays have occurred, they have, on reaching the hut, an hour to spend over the making and consuming of a very welcome afternoon tea. They then tidy up the hut, pack the reduced loads, and, after the guide has closed their last night's quarters, they leisurely descend in the cool of the evening to their hotel, where they arrive in plenty of time for a bath and shave before dinner is served, highly delighted, and not over-tired after their long and strenuous day.

SECTION IV

FOR THE LADY MOUNTAINEER

CHAPTER IX

CLIMBING

MOUNTAINEERING, like swimming, skating, and the now very popular winter sport of ski-running, seems to be eminently suitable for women, and they are taking to the rocks and the snows in ever-increasing numbers. The notes and advice contained in the rest of this volume are equally addressed to climbers of both sexes. In this chapter I give some suggestions which may be of special service to the girl or woman beginner. These are derived from a long and extensive experience of the aims and abilities, the wants and ways of the feminine mountaineer, from seven to umpty years of age.

A special section on dress is contributed by Miss Ruth Raeburn, President of the Ladies' Scottish Climbing Club.

The feminine mountaineer is by no means a modern phenomenon. France, a country always so rich in initiative, gives us the first instance of a woman taking up mountaineering as a sporting adventure. This lady was a Mlle D'Angeville.

A short biography of her has been published by Mlle Mary Paillon, of the French Alpine Club, also of the Ladies' Alpine Club of London.

Mlle D'Angeville, of an old Norman family, De Beaumont, was born in 1794, during the Terror. She made the ascent of Mont Blanc in 1832. It is true that, in 1829, a girl of Chamonix named Marie Paradis accompanied a party of guides to the summit. To this girl, therefore, belongs the honour of being the pioneer of her sex on the highest peak of the Alps.

Earlier still, in 1822, two Scottish ladies, Mrs. and Miss Campbell, crossed the Col du Géant.

Mlle D'Angeville was detained at Geneva for a week owing to bad weather. She thus describes her feelings while enduring this forced wait: "Le cœur me battait violemment. . . . Je me sentais une envie si ardente d'escalader qu'elle imprimait un mouvement à mès pieds."

She had six guides and six porters, and, as was the fashion in those days, carried (for them) a prodigious quantity of food and drink. She herself, however, ate almost nothing the three days of the ascent and descent. She describes her clothing most minutely; it would be considered far too heavy nowadays. She suffered somewhat from the "révèrbérations" of the snow, but, the day after her return, felt extraordinarily invigorated, and "twenty years younger." Like so many thousands since, she discovered that the secret of eternal youth, so far as it can be discovered on this earth, has been found by the Alpine climber. This lady proved this again, many years later, by ascending the Oldenhorn when sixty-nine years young.

The feminine pioneers on the Matterhorn were, on the Italian side, a daughter of the guide, J. B. Carrel, who accompanied her father and two other guides "to within 350 feet of the top," in 1867, and, on the Zermatt side, Miss Lucy Walker, sister of Mr. Horace Walker, who gained the Swiss summit in 1870.

Mrs. Le Blond has been the pioneer in winter climbing in Switzerland, as well as making new ascents in Norway.

Mrs. F. Bullock Workman has done far more high climbing and exploring than any other woman climber. Her record ascent, of Mer in the Himalayas, 22,742 feet, has been exceeded only by a very few men. In the Americas, Miss Dora Keen in the northern continent, Miss Annie Peck in the southern, have conquered great and new peaks. Recently we have a book by an Australian lady, Miss Freda Du Faur, dealing with New

Zealand climbing. Though a comparative novice, Miss Du Faur's beautifully illustrated and charmingly written volume proves her to possess the soul of a true mountaineer.

Many of the Continental, American, and Canadian Alpine Clubs admit ladies to membership, as does the Fell and Rock Club of the English Lake district. Most of the large continental clubs are, however, really tourist associations, and climbing qualifications are not required.

The first purely feminine mountaineering club was founded in London in 1907, under the title of the Ladies' Alpine Club. The Ladies' Scottish Climbing Club, more especially for the home mountains, was founded next year, 1908, in Edinburgh. Every year sees a larger number of the lady members of the Fell and Rock Club of Lakeland.

. . . . .

If we take two absolute novices on rocks, say a youth of twenty and a girl of the same age, we shall usually find that the girl is quicker at picking up right methods, and is safer at first than the boy.

The girl's advantages in learning safe rock-climbing are three in number :

(*a*) She has smaller feet.

(*b*) Lower centre of gravity.

(*c*) Relatively to weight, much less powerful hands and arms.

The last is the most important. Realising her weakness in this respect, the girl will pay all the more attention to footholds. A and B will assist her in finding these, and in keeping her balance on them when found. C is, however, a heavy handicap on long, hard climbs. Especially important is it, therefore, for the girl climber to save her hands' and arms' strength as much as possible. In holding on to rocks, it is not as grippers, but as anchors, that the hands should be employed. It is far safer and much less fatiguing, even on footholds only an inch or two in width, to hold

the body vertical, pushing out from the slope, if very steep, than to crouch against it, holding on tightly with bent arms. Only when actually pulling up should the grip be firm. Everyone who has used parallel bars will know how much easier it is to support the weight of the body when the arms are straight than when they are flexed. It is, therefore, important to get out of the flexed position as soon as possible.

The arms should not be held above the head a moment longer than is necessary. In this position the blood is apt to leave the fingers and hands, making them chilly and uncertain.

In moving up from one position to another on a rock-face, it is a mistake to select the highest hold within reach and haul the body up by it. Rather the lowest possible should be used, and the press-down method employed. The weight should be pushed up, and the arms used as much like the legs as possible.

Good, safe climbing, on long, hard climbs is very largely a matter of hip and shoulder work; it is, therefore, important that clothing be worn which interferes with the action of these muscles as little as possible. It will be found that the lady prefers, and is better suited for, open face and arête climbs, even of the airiest, than narrow cracks and chimneys. The former is really finer climbing, and is less dependent upon mere strength. When narrow chimneys have to be ascended or descended, the rule there is, "Keep as far out as possible." It is often tempting, and looks safer, to keep as far in as possible. This makes the work far harder, and will assuredly lead to jamming.

In learning the correct attitude to assume on steep rock climbs it is as well to avail oneself, at first, of the assistance of the rope held from above. This should not be pulled hard, however, as this prevents the safety of the footholds from being realised.

Should the novice or lady climber, in the course of the expedition, arrive at a pitch which is obviously beyond her unaided powers, it is not fair to herself,

and not kind to the others, to waste her strength, and the party's time, in futile efforts to get up without some slight assistance from the rope. At the same time, it must be most exasperating, just as she has got good holds and is coming on nicely, to be jerked off them and her feet by the "yanking" guide, or, worse, by the amateur. The guide who does that is a stupid ass, the amateur is probably, in addition, a shower-off whose conceit is far in excess of his ability. He will probably be unsafe, and pretty certain to come to grief himself sooner or later, because thoughtless and inconsiderate of others. The "yanker," whether guide or amateur, should never be given a second chance of leading a lady climber thus treated.

Every lady mountaineer should carry a small rucksack on a long expedition. The satchel sometimes recommended is a nuisance; it swings round and gets in the way just at the wrong moments. The sack is not in the way, does not interfere with the balance, and in itself need weigh not more than a few ounces. It will be found an immense convenience to have any small articles of personal use where they are at once available. The pockets of the climbing-suit will usually be quite inadequate for these.

The young lady beginner at mountaineering, and even some who are not beginners and ought to know better, seem peculiarly apt to commit the error of commencing the climb at too fast a pace. Of course this is a youthful failing, and those who are physically and mentally active find it hard to remember that there is a long, long way to go, and that the race is not always to the swift at the start. This error is one of the chief causes of "mountain sickness" and failure on long expeditions. It is less likely to be allowed if the lady is with guides. It is only the young and foolish guide who permits himself to be hurried for the first few hours. If allowed, it is almost certain to spoil the climb for the lady climber, and for the party, if she is with others.

A method sometimes adopted with the girl novice in the Alps is calculated to quench any budding climbing ambitions she may possess. For some mysterious reason, a long and fatiguing snow-grind is considered as a suitable "easy day for a lady." The girl starts for this, led by the usual mechanical "piece-work" guide. The peak is high, if easy, and she has little or no previous training. She has passed the previous night in a dirty, noisy, crowded hut, and naturally has not slept. On the ascent she has no time to see anything, except the guide's boots and the holes in the snow made by these. She wants to stop, he does not; growls "Avalanches," and on they go. On the top she has a splitting headache, and cannot eat. This is, of course, the "mountain sickness" of the ancient Alpine wiseacres. It is, in fact, nothing but want of training, want of sleep, and ascending too fast. They descend in even softer snow, the girl very done, but too plucky to acknowledge it. Her face has, most likely, been insufficiently protected. Result: another sleepless night, suffering severe pain, and next morning she is a repulsive object, cannot go out without a veil, and prefers to take her meals alone. In addition she is probably feeling the effects upon her feet of the thick, heavy, clumsy boots which she has worn with only one pair of stockings. No wonder she thinks, "Le jeu ne vallait pas la chandelle."

Let me assure the doubting, scared by the spectacle of one of these victims, that there is no need to get "mountain sickness," no occasion to achieve blisters, and not the slightest necessity to have thrust upon her the blushing and painful distinction of "glacier face." From under a thin, well-applied coating of "Pomade Séchéhaye" her face will emerge, on the evening of a day spent upon the snows, as fresh as when she started in the morning. A few drops of olive-oil renders the pomade easily washed off. If her boots have thin, well-fitting uppers, are moderate in weight, properly designed, and she wears double foot-coverings,

her feet will keep free from blisters. As regards boots, while there is no necessity for a woman climber to wear the big and clumsy boots often offered her, the boots must be strong. Neither heels nor welts should project; but it is especially to be noted that on no account should boots be worn with heels which slope inwards: these are bad and dangerous. The heels, therefore, should be straight, fairly low, and like a man's.

The majority of people will be entirely free from mountain sickness—up to heights, at any rate, which exist in the Alps—if they are in good health, begin gradually, and do not over-fatigue themselves. A mixed rock and snow ascent is much less fatiguing than a simple snow-grind. On the rocks there are frequent halts, and a far greater variety of muscles are employed. The distribution of effort, and, even more important, the greater interest and variety of such a climb, with its effect upon the mind, leads to a corresponding diminution of fatigue.

The average lady mountaineer should not attempt to carry a man's axe. Her weapon need not be a toy, however, but much like the axe described in the chapter on "Equipment," somewhat lighter in the shaft and head, and proportioned to the bearers' height. Excellent ladies' axes can be bought in most large Alpine climbing centres.

It is greatly to be recommended to the girl novice, and to all novices, to practise "bouldering" as much as possible, and for the girl, to select these boulder climbs, where activity and balance are of greater value than muscular strength and arm-pulls. She will there, often be able to show a more experienced and much more powerful man, how a short piece of difficult rock can be climbed with ease and grace. Unless the climb is under ten feet in height, with a good turf landing, the rope should always be put on. Below that height no injury should occur to any young person who takes care to alight *à la chat*, on feet and hands at the same time.

Bouldering is reputed to be bad for the skin. Gloves should always be worn. These ought to be thin and easy, without being loose. The shins may be protected by puttees. Unless the knickers have double knees, it is as well to tie on protectors, both for the sake of the knees and of the knickers. These can be made of a couple of large handkerchiefs or old scarves. With gloves, puttees, and knee-pads on, an hour's hard boulder practice should not result in the smallest damage to the tenderest skin. Bouldering is of great use in teaching what small holds can be employed with safety—at a pinch—on great climbs. It has also a wonderful effect in improving the balance, and in teaching the correct attitudes to assume, and efforts to make, on various kinds of holds. On a single fifteen-foot boulder one may find a series of climbs containing all the characteristic difficulties one will encounter in a whole day's climb on a great rock-peak.

In bringing this short section to a close I would say to the feminine mountaineer, and in fact to all would-be mountaineers, do not wait till you go to the Alps to learn at least the elements of the art. Moderate rock-climbing is the finest exercise in the world ; there is not a muscle it does not exercise. It is carried out in the world's finest scenery. Hill-walking is next best to rock-climbing, and the lovely airs and scenic glories of our own native hills are well worth knowing intimately. If you are a good dancer, skater, or ski-runner, balance will come easily to you. When you do go to the Alps, do not rush the climbing. Be very careful of your companions, whether guides or amateurs. Do not go a long expedition, unless you know your leader is able and experienced. Remember that, however good a leader may be on British rocks, if without Alpine experience, he is quite unfit to lead a guideless party on the snow-peaks.

LADIES' CLIMBING COSTUME.

CHAPTER X

DRESS

By Ruth Raeburn

In considering clothing from a mountaineering point of view, special attention must be given to lightness and warmth. It is better to take extra wraps, which can be used when required, than to burden one's self at the start with too many heavy clothes. It is hardly necessary to say, in this enlightened age, that all garments must be loose. The modern athletic girl does not need to be told that the ordinary corset is undesirable. She has found that out for herself, and is more apt to go to the opposite extreme, and dispense with it altogether. There is moderation in all things, however, and many women will find that a corset bodice of pliable material, and without bones, gives a certain amount of support to the body, and is quite suitable for climbing. On the scientific principle that air between the clothing and the body conduces to both coolness and warmth, it is desirable to wear two suits of fairly thin woollen combinations rather than one thick one.

The costume usually adopted by women climbers is a coat and skirt, flannel blouse, and knickerbockers. The coat should be of a strong, thick, closely woven material, and one which sheds the water readily. It should be made as nearly as possible like a man's coat, straight-fronted and double-breasted. It should have outside pockets with flaps to button, and small inside pockets. It should also fit very loosely, so that a jersey may be worn without discomfort beneath it.

Here it is perhaps not unnecessary to add a warning about the arm-holes, which must be made particularly easy, so as to allow free play for the arms. Lastly, it should be lined with Jaeger flannel, which is delightfully warm and light, and does not shrink when wet. The knickerbockers, of the same material as the coat, should be made by a first-class tailor, and care should be taken that he does not make them too tight, which he is liable to do in his praiseworthy effort to achieve a smart effect. In this case, however, the garments are wanted for use and hard work, rather than for ornament, and all attempts to smarten them at the expense of the wearer's comfort and safety must be sternly repressed. A short, unlined skirt of some lighter material, which can be conveniently stowed in a rucksack, completes the outer covering of the body.

The head should be well protected, and to ensure this a felt hat, which can be pulled down over the ears, is considered better than a woollen cap. The latter absorbs moisture, does not keep out the wind, does not shed the rain, and does not offer sufficient protection against the sun.

Many beginners suffer considerably from blistered feet, and even look upon the condition as inevitable; but this is not so, for by taking a few simple precautions the worst results can usually be avoided. To begin with, the boots are all-important to a climber, and these should be sufficiently large to allow of a pair of socks being worn over the stockings. A boy's sock of 9 or $9\frac{1}{2}$ inches usually fits the average woman's foot. Here, again, we have a layer of air between the sock and the stocking, and by this means the feet are kept warmer, while there is less friction on them, as the two thicknesses of wool rub against each other. It is a mistake to wear very heavy boots, in the hope that they will keep out the wet. No boot really keeps out the wet when subjected to prolonged soaking, such as climbers have so often to face; so it is better to have a light, comfortable boot, which makes no pretence of

doing so. The welt should not project a hair's-breadth, as to do so is dangerous, and might cause an accident when everything depends on nicety of balance on an almost invisible foothold.

A rucksack is indispensable for every climber, but this should be of a strictly moderate size, and contain only the bare necessities of climbing life, such as spare jersey, extra pair of warm gloves, handkerchief, muffler when not being worn, collapsible leather drinking-cup, compass, and map.

It is the aim of the writer of these pages to give only a few general suggestions, all of which have been tried and found useful, but everyone has a more or less individual taste in matters of dress, and will probably follow their own ideas to a great extent. Experience alone can teach the climber just what to take, and what to leave behind. Conditions themselves are so variable that no definite rules can be laid down for the complete guidance of climbers.

The celebrated French *alpiniste*, Mlle Mary Paillon, writes: "Abandon everything which is not absolutely essential, for comfort in climbing depends upon feeling oneself light and mobile"; and that is probably the best advice that anyone can give.

To those who have once felt the attraction of the mountains, no better sport than climbing can offer itself. It is at once a revelation and a realisation: undreamed-of possibilities unfold themselves, and with every step upwards our vision enlarges, limitations disappear, difficulties apparently insurmountable are overcome, and we are filled with a sense of well-being and contentment.

SECTION V

GENERAL PRINCIPLES

CHAPTER XI

ETHICS AND RULES
WITH SOME GENERAL CONSIDERATIONS

THERE would be little need of mention of mountaineering ethics, if the golden rule of ethics were always kept in mind.

We are all apt to be forgetful at times, however. Keen, eager beginners, out of pure thoughtlessness or ignorance, may sometimes fail to exhibit a proper consideration for other mountaineers or sportsmen, whom they may happen to encounter, or be with, upon the heights.

It would be beyond the wisdom of anyone to draw up a set of rules to fit all the conditions of a sport or pursuit whose great benefit, beauty, and attraction is its "infinite variety." I do not attempt it here.

Perhaps the most comprehensive short rule which could readily be devised is this threefold one: "Conserve energy, don't waste time, and always be careful."

If in this chapter it is found that I seem to modify or neglect any of the excellent rules compiled by former writers on mountaineering, it will, I hope, be found that this has only been done in the case of those rules which the progress of mountaineering has modified, or which, if strictly adhered to, might tend to put a stop to all progress or enterprise.

It has been advised that "No beginner should start climbing with the idea that he may one day wish to dispense with the assistance of guides."

I would prefer to retain this rule with the sole alteration of "No" into "Every." A very much

greater degree of care and attention will now be infused into the beginner's climbing methods. Even if he does not care to climb without guides, or never acquires sufficient skill, he will render himself a much safer and more pleasant companion to his guides, his friends, and most of all to his porter.

A rule which used to be strongly urged in less crowded days, was that there should never be more than two parties upon a rock-peak at one time. The danger to be guarded against was, of course, that of falling stones. Such a rule is a hopeless ideal nowadays, at the great centres, in fine weather. It is no uncommon event for from forty to fifty people to be on the Matterhorn, for instance, in one day. They may not all get up, of course.

After all, however, in spite of the great increase of travellers, the risk has not proportionately risen. This is due to the straightening out, the path-making, the throwing down of loose stones, and the avoidance of places where stones are likeliest to fall.

That the danger is real still is proved by the many accidents, some few fatal, which take place on these crowded rock-peaks. In most cases these accidents could have been avoided by a little give and take, and waiting on each other, at places where disturbance of stones was probable. It may be very annoying to have to keep behind a party which is sending down stones, but it should be noted that a following party has no right to race past the leaders, and perhaps send down stones on them.

Racing on climbs is utterly bad form, and has been a fruitful source of accident. Permission to pass should always be asked. The party which starts first from the hut has the precedence on the mountain.

If the parties are with guides, the guides, if they know each other, will probably arrange the order of precedence among themselves. The guideless party is in the worst case. Should they be allowed, having started first, to endanger or keep back, by clumsiness,

or ignorance of the route, or not being sufficiently skilful to make their own way, a following guided party ?

If they follow a guided party, can they declare themselves a "guideless" party ? "Payless" might seem a more suitable term. Guides are, as a rule, a most polite and considerate body of men. We could hardly blame them, should they be tempted to exhibit signs of temper at finding their charges endangered, or kept back, by irresponsibles.

The fact is that these "popular peaks" are not suited to guideless climbers who desire to deserve the name of "mountaineer."

The routes are so well worn and well marked, there are so many parties on the standard Alpine routes in the high season, that little scope is left for the practice of the higher art of mountaineering. They may be most enjoyable climbs, repaying in the extreme from the scenic or the athletic point of view; but the Alpine man who confines himself to them, whether with guides or without, has hardly the right to look down upon British rock-climbing as "not mountaineering."

It should be most carefully noted, however, that the first ascent for the season of any of the great peaks, or their attempted ascent in bad conditions, is a very different thing from the climb in fine weather in mid-August. The mountains are still the same, and can be as formidable and dangerous as they ever were.

Even the Matterhorn, that chained and degraded "Samson bound to make sport for the Philistines," can be very terrible in a sudden storm.

Young people of either sex should not be taken on long and difficult Alpine expeditions before the age of eighteen or nineteen, however strong and active they may be. Except in the case of a few individuals, they are not fitted to endure long-continued exertion. The war age has not been fixed without good reason.

There is no cause, however, why boys and girls

should not go on our own home hills or rocks. We have no elevation which makes any practical difference in the density of the air.

Even the difficult Dolomite climbs are much less exhausting than the ascent of the great Alpine peaks. Dolomite climbing, in fact, from the path and hut organisation, often the roping, and especially the foot-gear employed, the light, soft, *kletterschuhe* or scarpetti, is usually considerably easier and less fatiguing than average British rock-climbing. Many famous Dolomite climbs are no longer, and are less difficult, than some British rock climbs.

Some remarkable records in climbing have certainly been made by children. Thus Captain Charles Inglis Clark, A.C., ascended the Matterhorn when a boy of fourteen. A young girl, Miss Flossie Morse, made the ascent to the top of Mont Blanc when only twelve. Even this record has been beaten by a little Chamonix boy, a son of Monsieur and Madame Charlet-Stratton, who fought and fell for his country in the Great War, as did also Captain Clark. This boy accompanied his parents to the summit of Mont Blanc when only $11\frac{1}{2}$ years old. All these children, however, had been accustomed to climbing for years, and were in the best of health and training at the time of their ascents. Certainly in their cases no ill effects were felt. Nevertheless, the rule enunciated at the beginning of this passage should not be lightly disregarded.

Perhaps it is a case of "A fellow feeling makes us wondrous kind," but I wish to put in a plea here for the Alpine porter. I mean especially the young porter. It was not always sufficiently recognised how much of his scansorial shortcomings might be due to his overloaded condition. Of course, it is the guides who are to blame, as a rule, when the porter is overloaded; but the traveller should not allow this. If he is luxuriously minded, and requires large quantities of food and drink, let him hire another porter. If not, let him jettison a few unnecessaries, such as tins of fruit,

thermos flasks, and bottles, and the result will be well shown in greater speed, less anxiety, and far less risk.

It is certainly surprising to see the enormous loads which are carried by the young people, even quite small girls, of Alpine countries; but, though early and constant use can do wonders, the over-loading of the willing horse can be, and too often is, I am afraid, carried too far.

There is little difficulty for the average healthy young man or young woman of normal balance, in learning the elements of the climbing craft, and in becoming, in a very short time, perfectly competent to form one of a properly led roped party.

To take the place of *that* leader is a very different matter. Anyone who aspires to lead a party of amateurs on the high snows ought to have gone through a long and careful apprenticeship. It is not at all necessary for this apprenticeship, in its earlier stages at any rate, to be gone through in Alpine regions above snow-level. The best Alpine guides usually served it well below that

The ability to climb difficult rocks, to cut steps up and down steep ice, to have perfect balance and never slip, and to have great endurance, are the smaller, less important part of the requirements of a really good guide or leader.

More important are the possession of an apparently intuitive eye for country, an "instinct" for route-finding, or so-called "bump of locality," a great power of judging time and space, and a wide knowledge of mountain structure. In short, a real mountaineering leader is the man who "understands" mountains.

Some years ago an old man in a French village possessed an almost uncanny power over the wild animals and birds which dwelt in his vicinity. He was asked, one day, how he could account for it. He replied, "As for the birds, I *love* them, I *know* their *ways*; the *wild* ones will come and eat out of my hands."

The second on the rope has also his duties and

responsibilities. He must look after the leader's rope when the first man is engaged on rocks of some difficulty —seeing that it runs out freely—and should look for and use all available hitches which do not check the leader's upward progress. He should be prepared to give the leader actual physical assistance where this is necessary, if this can be done safely ; but, with a competent leader, such assistance should be very rarely required. He will also have to look after the third man's rope when it is his turn to move. He may have to repay to number three, who will probably be the heaviest loaded, the small amount of assistance he may have received from number one on a difficult pitch.

It is not one of the second man's duties to offer unasked advice regarding the route to be followed, or the holds to be used by the leader. Holds viewed from the angle of the first and second man, on a steep rock face, are very different things. What looks like a nice, comfortable, square ledge may be in reality very dangerous, or quite impossible to use. I have known of a case, on a new climb, where a *third* man kept up a stream of advice to the leader. The second on the rope, however, happened to be a relation of his, and threw down upon, and silenced him with, a few remarks of a crushingly Johnsonian nature.

Of course, if number two is an expert, who is coaching a novice up a known climb, the case is quite different.

C in a party of three has apparently the least to do, but this is only so on certain short, steep, *upward* rock climbs. He is generally, in any case, the heaviest loaded, and has the onerous duty of leading down on the descent.[1]

There is one important point, curiously enough often forgotten by even experienced climbers, which all members of a roped party must carefully note. After passing a slight difficulty which has delayed them, they must not at once put on pace on the easier ground

[1] See Chapter VIII.

beyond. They must remember that the comrade behind them has still to pass the place where *they* slowed down.

Fitness

A party ought all to be in very good condition before a long, hard climb is attacked.

This would seem such a very obvious requirement, that it might almost be thought superfluous to mention it. As a matter of fact, it is one of the most frequently trangressed of mountaineering rules. The lower slopes of popular peaks are often strewn with their collapsed would-be conquerors, whose appetite for the ascent has been more than their digestion of it. I have met, in Alpine huts, strong, active young climbers, utterly collapsed, who, proud of their ability to tackle the longest and hardest climbs on British rocks, have rushed at comparatively easy though high peaks, such as the Dent Blanche, without training, or first finding out whether they were affected by altitude or not. The man who does this is, to put it bluntly, a fool.

It should also be remembered that the man who goes with a party, more especially if it is a guideless one, while feeling himself really unfit, may easily throw a heavy strain, both physical and mental, not only on himself, but also on his companions or guides. The condition of the climber is thus important; almost more so is condition of the mountain. This is what makes the record times given in some guide-books so often misleading.

Records are, in fact, usually more or less fakes. Thus the motor-car maker, who wishes to put up a speed record, selects a hard, flat stretch of sand ten miles long, strips the car, waits for a gale behind, and picks out the mile speed in the middle. Very remarkable, but not the faintest proof that his car is better, faster, or as fast, as a dozen others whose speed record has not been faked. Alpine climbing, of all sports, holds out

greatest opportunities to the record-breaking fakist, as condition of the mountain is such a vitally important factor in the speed of the ascent. The same party, in the same training, may take more than twice the time to ascend and descend, say the Matterhorn, in May or June than they do in August. Whatever be the condition, let us hope all record-breaking efforts will be avoided by real mountaineers. "Don't *waste* time" is a perfectly correct rule. That really means, conserve time as one does energy: always have a reserve to fall back upon if required.

An Alpine Modification

The climber on British crags is told always to hitch, and always to move one at a time, when on rocks of some difficulty. The advice is sound, and should always be most carefully adhered to. He will be somewhat surprised, on going to the Alps or Dolomites, to find that the guides very rarely do these things, —nor, on the whole, is it often necessary to be done by them. Though the average standard of climbing is much lower than on the short British climbs, the climbs themselves are much longer. The element of time is very important.

On slopes which are at all *steep*, it is very easy for the guide or *practised* leader to stop a man who slips or falls, whether on rocks or ice, from *close* below him, and ceaseless vigilance becomes a good guide's second nature. If hitching and stopping, at every place of some slight difficulty, were to be practised in the Alps, the longer climbs would, with amateurs in parties of three and four, almost invariably result in the party being benighted. The method would not be allowed by a guide, especially a piece-work man.

The somewhat niggling methods of climbing, customary and necessary on British climbs, with parties very often containing "weak," that is, unsteady members, and with leaders who may not yet have

reached even the journeyman stage in rock-craft, are not suitable for the high Alps.

A young British rock-climber may have a very natural and laudable ambition to go with, or lead, an amateur party in the Alps. He may have done a long list of rock "courses." The point is, however, not that he has done these, but he should ask himself *how* did he do them? Did he do them with an ample margin of safety, apart from hitching, belaying, backing up, and combined tactics? If not, he is not justified in attacking great peaks without guides, apart from other requirements.

Straying

If the party is a guided one, straying—by which I mean the party splitting up, and wandering off in different directions—is not likely to occur. The amateur is certainly unwise who thinks he knows the ground better than a guide, who also is a native of it. Straying is more probable with a guideless party.

Nothing is more likely to lead to annoyance, loss of temper, of time, and of the way, to cause the party to get benighted, to be a fruitful source of accidents, perhaps to lead to the total break-up of the party.

It is likeliest to occur on the homeward route, after the nominally difficult places have been overcome, and the rope, of course, taken off. The root of this trouble lies in the party not having a definite leader. Equality is an excellent principle if all were equally skilled. This never occurs in practice. It is not necessarily the case that the leader of the ascent on the rocks, or the ice, should also be the leader on the easy homeward route, but there ought to be *a* leader. The members of a party ought never to get out of sight of each other until a definite path is reached. For the purpose of keeping within earshot when out of sight of each other,

every member of a party should carry a siren or other whistle.

The Alpine Distress-signal

This consists of a succession of sounds, or of flashes at night, or heliographed by day. These must be made at the rate of six per minute, with one minute's interval. In replying, the rate is to be three per minute, with the same interval.

Roping Peaks

It has been said that the roping of peaks, like the "roping" of horses, should be anathema to all true sportsmen.

There are, however, I consider, a few places on Alpine peaks where this is perhaps allowable.

If there exist, high up, one or two passages where the rottenness of the rocks, the liability to become iced, or the intrinsic difficulty, reduce the margin of safety for even the first-rate guide or leader too low; these, I think, may allowably be roped. A few such places are: the Meije arêtes in Dauphiné, at the "Capucin" and "Pic Zsigmondy"; the South Aiguille D'Arves, also in Dauphiné, at the "Mauvais Pas"; the Zinal arête of the Dent Blanche, at a great gendarme; the Petit Dru, the ice-chimney below the "Shoulder"; and a few others.

The Grépon is not roped, nor do I consider it contains any passage which ought to be roped.[1]

The reason for the extensive roping of Alpine peaks in modern times is, that thereby the inferior guides are enabled to earn as much money as those superior to them, by the roping enabling them to hoist and let

[1] A guide, a Grépon expert, in apostrophising the peak, says: "Le Grépon c'est un grand Diable, et il faut d'avoir des bons bras et le cœur fidèle pour aller à bout. . . . Mais c'est aussi un ennemi loyal, ne fuyant jamais. . . ."

down themselves and their tourists, on mountains and routes, otherwise quite out of their power.

This wholesale roping has, however, brought with it a kind of Nemesis. It encourages on these routes numbers of "guideless" climbers, who swarm up the guides' fixed ropes, and fall down them, and pay nothing to anyone—except Charon.

These routes even become infested by the "solitary climber," or *alleinganger*. This is usually not a mountaineer, and not a "solitary" climber at all. He would never care to climb on places where he had no spectators. He is usually a young, thoughtless person, with a cranium considerably too large for the contained brain. As he has no rope, he is able to move faster on the easy, well-marked rocks of the popular peaks, than can a roped party, even with good guides. He possibly imagines this party admires his skill and agility. In reality he is a dangerous nuisance, and an ass; but he is quite hurt when told that truth by some exasperated guide, whose "Monsieur" he has just missed killing with a stone.

Number in the Party

This so varies, according to the kind of climb, and the composition and capabilities of the party, that no general rule applies. Any number on a rope exceeding four will be very slow on rocks of some difficulty.

On easy glaciers, or simple snow ascents, large numbers may often be seen on a single rope, almost like beads on a string; but such parties are not composed of mountaineers.

The Party of Four

For average climbs and for average Alpine conditions the *parti carré* is, in my opinion, the most suitable. It stands like a fort, four-square to all the Alpine winds of accident or of labour which may blow upon it.

With such a party serious mishap on a glacier should be well-nigh impossible. If it contains two members who are capable of leading upon difficult rocks, the second of these need not be a "guide"; its pace on these rocks will not be slower, but faster, than the party of three, if it is split up into two ropes of two each. If the party is even a moderately competent one, four should enable the load of the leader to be reduced to a minimum, or of his being relieved of a load altogether.

In deep snow it can ring the changes of leadership four times within the hour—a very important point in such exhausting conditions for the *pro tem.* leader. Should an accident happen to a single member, one can stay with the injured man, while the other two go for assistance.

In exploratory work beyond the Alps, four is the ideal number for the climbing party: the temporary sickness of a member, or even two, need not stop altogether the party's activities.

Three on a Rope

Three was the number declared to be the absolute minimum allowable, by the leading British authorities of last century. Had they added "on crevassed glaciers for novices, and not yet mountaineers," little fault could be found with this rule. There are places and parties for which the smaller number, two, is safer and more suitable. I shall deal with the two cases together.

Two on a Rope

Many years ago it was somewhat sweepingly and dogmatically stated by a writer in the *Alpine Journal*: "Whatever number is right, two is unquestionably wrong."

This opinion has sometimes been treated by writers on mountaineering as infallible logic. As a matter of fact the opinion, and the practice, of most first-class

mountaineers is, and has been, in direct contradiction of this dictum.

Professor John Ball, F.R.S., who edited the well-known series of *Alpine Guides*, writes thus: "I am of the opinion that two first-rate mountaineers are perfectly capable of carrying out any expedition, and that they are just as likely to succeed as a larger number." He also explains and elaborates his position farther on. Professor Tyndall, with Bennen, *or* Lauener, had no hesitation in attacking, and safely conquering, the greatest summits of the Alps, as far back as the 50's of last century.

Professor J. D. Forbes, and in fact most of the scientific pioneers of climbing, were of similar opinion and practice to Ball and Tyndall. In more modern days, Mr. A. F. Mummery, one of the finest of mountaineers, was also of the opinion of Professor Ball, and of course practised on a much larger scale.

Practically all the best professional guides were perfectly willing, and considered and proved it perfectly safe, to go alone with an *able* and *competent* amateur.

Mr. Mummery went frequently alone with Alexander Burgener and other guides. He conquered the great rock and ice-peak of Dykh-Tau (17,054 feet) in the Caucasus, with a single guide (Zurfluh).

Messrs. Longstaff and Rolleston in that range in 1903, Messrs. Egger and Miescher in 1914, conquered high and difficult snow-peaks. Messrs. Rubinson and Monraad Aas, gained, in 1907, the greatest height then reached on earth, on the north-east peak of Kabru in Sikkim (23,900 feet), by themselves.

Alexander Burgener of Saas, Ulrich Almer of Grindelwald, Emil Rey of Courmayeur, had never any hesitation in conducting, single-handed, any amateur whose capabilities they knew.

The advocates of the "never less than three" party took up the absurd and illogical position of basing their minimum on the position of the party *after* an

accident has happened to one member, and laying very strong emphasis on the concealed crevasse glacier as a main danger.

If, however, we are to base our climbing number on such a supposition, then I think we must have not three, but five members.

It is rightly one of the strictest canons of mountaineering ethics, that an injured member must not be left alone upon a mountain. If we have a man injured in our party of three we must either break this law, or commit the hardly less heinous "crime," to the three-minimum man, of sending a party of *one* down the mountain and over the crevassed glacier.

In analyses of Alpine accidents I have seen "two on a rope" calmly stated as a *cause* of a certain accident by some of these "three" purists, not one particle of evidence being given that this was really so. They simply assumed that three was the correct number; therefore, seeing there were only two, this was the cause of the accident!

Fact, arithmetic, and common sense are enough to show that, other things being equal, there is about 33⅓ per cent. less chance of an accident happening to two than to three climbers. This is considerably understating the advantages of two in the reduction of chance of accident. In actual practice, it is impossible to get together three climbers who are exactly equal in mountaineering ability. The probable advantage from dropping the weakest, and most likely to cause an accident, is much greater than 33⅓ per cent.; it may be more than 50 per cent. Even in the case of the crevassed glacier, the stock argument of the triplices, two careful and experienced men will not fall into crevasses at all, which the careless and clumsy third will drop into as naturally as into his club.

Let us carry the case *ad absurdum*. What possible advantage could it be, from the point of view of safety, whatever it might from the point of view of pocket, to two able and experienced guides, to be roped

to a "great, drunken, terrified marmot" of an amateur ? [1]

Of course, it is really far more important to prevent accidents than to endeavour to mitigate their effects.

This is to be done by carefulness and technical knowledge. Two good men are far safer than three ignoramuses, even on a crevassed glacier.

It will thus be seen that a party of two on a glacier is an expert's game. A novice may join any party of two experienced men: he most certainly ought not to form one of such a number, even though the other is a guide.

A very great advantage for the party of two on a difficult rock mountain is, that they are able to adopt the great safeguard of hitching, and only moving one at a time, much more freely than a larger party, and yet not lose too much time. Every additional man on the rope on a climb of some difficulty, either adds enormously to the time required, or else to the danger.

Mr. Mummery, for the sake of extra security for a party of two on a crevassed, snow-covered glacier, proposed (and practised ?) the carrying of a double rope. This, however, is clumsy, and if it gets twisted, is then really one rope.

A better plan is for both men to tie on with the bowline on a bight knot, and for each to carry half the reserve cord, with a stirrup already made on it.[2] If now either fall in at all, it should not be very difficult for the one outside to extract the other. If the two are keeping at proper intervals for such a party,—twenty or even thirty feet is not too much, with no slack on the rope,—there should be no difficulty in stopping the faller in a few feet, and thus preventing injury. If there has been no obvious sign of the crevasse, the snow is so thick that it is an easy matter for the outside man to get a hitch with his axe.[3] He *belays* the insider

[1] Michelet, *La Montagne*, quoting guides' overheard talk regarding their "Monsieur."

[2] See Chapter IV, p. 62.

[3] See Chapter VI, p. 82.

to this, while he goes to the edge of the crevasse and passes him down the end of his stirrup-rope. If "inside" can help himself at all the task of getting him out should not be difficult.

It should be remembered that "outside" can gain power, equal to at least two men hauling with their arms, by using the Yorkshire seafowls' egg "klimmers'" method.[1] This is done by sitting down, passing the rope round the small of the back, and hoisting by bending and straightening the thighs.

Best Order on the Rope

For "guides" may be read, the better climbers.

In the case of the party of two there is no difficulty: the guide leads up and follows down.

For the order when three are on the rope I have already expressed my opinion. That is, that the weakest of the party should in general be placed between the other two. On extra difficult pure ascents, either on rock or ice, it may be better for the weakest to go last, but never lowest on the descent. By weakest is of course meant the least good and practised climber. Physical strength has nothing to do with this.

When the party consists of four, the case is rather more complicated.

We shall suppose the party to consist of two guides, G1 and G2, and two amateurs, A1 and A2.

The order will then be, G1, A1, G2, A2; but it will not do to reverse this on the descent if both A1 and A2 are inexperienced. It is also not permissible to have two inexperienced climbers together on the rope. Really, in this case, two guides are not enough; we must add G3.

The order down will then be G3, A2, G2, A1, G1. Five on a rope is, however, as has been elsewhere mentioned, a slow party. I consider it would be better

[1] See Chapter III, p. 51.

to split it thus: G1–A1 and G2–A2–G3. This is the order up. For the descent, reverse; no rearrangement is required. A guide leads down, the weaker tourist is between two guides.

The smaller party keeps close behind G2, so that A1 has no route to find, and can always, if necessary, be shown his footholds, or receive assistance otherwise from G2, without the here unnecessary complication of the rope. This supposes, of course, that G2 is nearly as good as G1, and quite competent to come down last.

If one of the amateurs is competent to lead down, and G1 and G2 are nearly equal, there is no necessity for the third G, and I think the party would in this case be as safe, and certainly would be faster, if it was also split up into two ropes.[1]

Climbing Unroped, and Climbing Alone

If climbing "two on a rope" has been banned by some British Alpine authorities, climbing unroped or alone has been utterly damned. They seem to have forgotten that the general use of the rope for mountaineering purposes, is of very modern origin.

In old Alpine narratives, as, for instance, the ascent of Mont Blanc, the members usually proceeded separately. Sometimes they held on to poles carried by the guides. Ropes seem to have been taken mainly for the purpose of hauling out of crevasses any of the army of guides and porters who happened to fall in. This event, as they seem to have been frequently pretty well fuddled, was far from rare.

Even in later times we learn, from the accounts of Alpine climbs, that the rope was only occasionally assumed at the more difficult passages, and not worn constantly from hut to hut, as is now more usual.

Far is it from my intention to condemn the use of the Alpine rope. It should always be assumed in places where danger could possibly occur, and, for the

[1] See p. 144.

tourist and inexperienced, is essential; but the Alpine rope is, like the crampon in these days, in danger of becoming a fetish, and used by incompetents to cover up thoroughly bad mountaineering.

To the leader of a mixed party, be he guide or competent amateur, the dangers of being attached to a rope are far greater than any benefit it confers. Few leading guides on a steep ice slope, or Dolomite experts on an extra difficult passage, but would feel much safer unroped.

The old rope "idolaters," the really scientific pioneers were not of the cult, who were so eager to condemn the solitary mountaineer on paper, were at the same time at one in showing a practical appreciation of him, by always seeking him out to act as their guide. The pioneer guides were almost always the most daring chamois-hunters of their respective districts. As such, they had gone through a long and hard apprenticeship to the art of mountaineering alone.[1]

They had begun on the proper place to learn: the lower heights below snow-level. There is no reason why an amateur should not equal them if he takes sufficient trouble.

This cannot be done, whether on the lesser or greater heights, in a season or two. The way of the expert is long and hard.

Nature is kind to her true lovers, but can be cruel, even killingly cruel, to the curious impertinent, or presumptuous ignorant. Her law of gravity never "forgets."

The best place, therefore, to learn the elements of mountaineering is on the lesser heights, where all the great guides learnt them. If the beginner rushes at high or difficult climbs, either at home or abroad, he

[1] Mr. H. M. Stutfield, in an article, "Mountain Sport," in the *Alpine Journal*, vol. xx., May 1900, treats the subject of glacier travel, unroped and alone, in a common-sense fashion. He writes: "As one has to spend a good deal of time on glaciers without a rope, some knowledge of ice and snow is indispensable."

is really attempting to practise the higher mathematics before he has mastered the multiplication-table.

Too often the would-be "Alpinist" rushes out to the snows. He is dragged up a few of the great peaks, in fine summer conditions, by strong, able guides. He returns, pleased and proud that now he can call himself an "Alpinist" indeed.

And so he can; but that title, honourable and correct in its French meaning, in English has quite other significance.

In English, "Alpinist" means a poor, pinchbeck imitation of a mountaineer, a meaner Tartarin, without the Tarrasconnais' innocence and *bonhomie*.[1]

Britain has wild and dangerous waves and currents round her shores, on which Britons can, and do, make friendship with the sea, and learn the ways of the ocean. Her winds are high, sudden, and fickle, the best and sternest schools for teaching the mastery of the skies. She has also large tracts of elevated, wild, and desolate country. No better ground exists anywhere for the training of the mountaineer. I do not write at present of British rock-climbing. Our schools of this are quite equal in ability, and much superior in safety, to the best of the continental schools, but it is to be regretted that fell walking, and scrambling, is less practised than it might be.

This is the opportunity for the solitary mountaineer. If he can find companions, well and good. If not, let him go alone, and go at all seasons. Take it easy, do not race; the mind cannot concentrate upon the effort for speed, and observe and note at the same time.

Go over a range in clear weather, come back and do the same in mist. Take map, compass, and aneroid, and study them. Occasionally leave all behind and go without. Too much map, and too much compass, have sometimes, like too much rubbers, and too much crampons, on rock and snow respectively, a bad and cramping effect upon mountaineering "instinct." Hide

[1] *Tartarin sur les Alpes*, Alphonse Daudet.

something about a hill-side. Go back in a day, week, month, or year, and find it again.

There are also many interests in every hill-walk which will unconsciously train the mountaineering memory.

The geologist will note the outcrops, the horizons, the dip of the rocks, and their nature ; will remember a pass, or the easiest route through a chaos of boulders, by the finding of some peculiar stone.

The mountain wild-flowers will speak in their own language to the botanist who loves them.

The naturalist will greet the birds and beasts of the hills, will know the approximate height above sea-level by the varying fauna as he climbs. He may find, in a mist, the crag he was seeking by hearing the thrice-repeated note of the ring-ousel, or the sharp, chiding cry of the kestrel, who, he knows, has her eyry on one of the high ledges.

The essence of true sportsmanship is consideration for others ; therefore, the mountaineer will avoid the deer-forest sanctuaries in the stalking season, and will refrain from tramping through the long heather of the grouse-moor during the nesting time.

If the would-be mountaineer on the greatest peaks in the world were to begin in this fashion, far more climbing would be done, with far fewer accidents.

He would be able to take his place on the climbing-rope with the assurance that he was not likely to be a source of weakness to his party, whether guided or not.

CHAPTER XII

HOW TO USE THE ICE-AXE, CRAMPONS, AND ROPE

THE management of the ice-axe, like that of the golf-club and cricket-bat, cannot be learned from a book. By far the best method of learning is to watch an expert at work.

The advice to do this is freely given to the novice in the Alps. Unfortunately for him, this advice is, nowadays, not always easy to follow. There are probably much fewer really expert axe-men in proportion among the guides of the great centres than formerly, and in the novice's first season he may make the ascent of half a dozen, say, of the Zermatt peaks without seeing the guides cut a single step ; all necessary steps having been already cut by preceding parties.

The ice-axe, to one who sees it for the first time, will appear an awkward, uncouth, and dangerous weapon, and in the hands of the complete novice it is certainly all these. It would seem a good plan to learn its feel and carriage, and to make some acquaintance, at least, with its uses before taking it on an Alpine expedition. By doing this, injury is much less likely to be inflicted upon its owner, his friends, or guides, and the axe is much less liable to be lost.

TREATMENT

Like a cricket-bat, the axe should receive an occasional dressing of oil. After use it should be carefully dried and polished, and the metal parts covered with a film of vaseline or thick oil. The leather hoods should then be replaced.

Carriage

The best way to carry an ice-axe, when not in use, is under the arm-pit, as one carries a gun. The gun is sometimes carried over the shoulder; so is the ice-axe, but it is less adapted for this position. It may also be carried at the trail, in which case the man in front should be warned. Ordinarily on the mountains it is used as a stick, or alpenstock, and this in fact is its main function for the majority of Alpine climbers, especially when with guides.

When travelling by rail or conveyance, an ice-axe should always have its points protected by covers. This is not so much for the axe's own sake, as for the sake of the fellow-travellers with it. One is no more justified in placing a naked ice-axe in the rack of a railway carriage than if it were a naked sword.

For the purpose of becoming familiar with the balance and "feel" of an ice-axe, and at the same time training the co-ordinance of hand, foot, and eye, the axe may be thrown into the air, caused to revolve a determined number of times, and caught on the descent, in either hand, as a good step-cutter should be ambidextrous. This is done while running down a steep slope without stopping.

N.B.—It is best to try this at first with a walking-stick, and, if an ice-axe is used, to see that the axe is muzzled at all three biting ends.

Step-cutting

The best place to learn how to carry and use an axe is probably on a winter climb at home. The naked glacier near some Alpine hotel is also a most excellent practice-ground. It should be noted, however, that it is very different work making steps in glacier ice below snow-level and cutting them in the hard, tough, low-temperature ice of the heights.

The ice-axe described in the chapter on "Equipment" is probably the one best suited to all the varying conditions and purposes, under and for which an axe is used. We shall now suppose that we are handling such an axe.

It will be observed that the shaft is everywhere oval. This not only means the placing of material where most required, it also allows of the axe-shaft falling into or remaining in the hands when cutting steps, without an effort being required to keep the pick straight.

Mr. Dent, in the Badminton volume on Mountaineering, quotes a famous old ice-guide, Melchior Anderegg, as saying: "In making steps, the ice-axe should be gripped firmly." This is quite correct if the ice-axe shaft is of a bad pattern, i.e. round, as was usually the case with old axes, and some of this pattern are still sold. With these, unless tightly gripped before, during, and after the blow, the axe-pick is very apt to slew round slightly. Power is thus to a great extent lost; the laboriously cut ice-step may be destroyed.

With our axe, we work just as loosely as is possible. No amateur could ever hope to be able to cut steps for many hours if he had to grip the axe-shaft tightly all the time. The aim is, as in all good-form mountaineering, not to expend a single ounce more force than necessary. We push, not pull, the blow. We make the axe do the bulk of the work. The only time the guiding hand—that nearest the axe-head—grips tightly, is just at the instant of the pick's contact with the ice. At this moment the axe may be pulled forward slightly with a picking motion; but this depends upon the stage and condition of the step in process of making.

Some guides are said to give a kind of half-turn to the pick, by means of the forefinger of the guiding hand, on its contact with the ice. Melchior Anderegg, according to Mr. Dent, "did not advance the forefinger except when using one hand only." One-

handed cutting is very hard and difficult work, and generally has to be done in an awkward position. Amateurs who do not possess the iron fingers of an Anderegg, will generally find it better to advance the thumb. The grip in this case must, of course, be firm, and cramp is pretty certain to develop if the cutting is long-continued.

Two-handed cutting should, in general, be done with an easy swing of the body moving from the hips, not merely with the arms. It will rarely be found necessary to lift the ice-axe higher than the head, even in the somewhat crouching position necessitated by the modern short shaft. Correct aim and delivery are far more important than violence of blow. It will be found of advantage, in determining the "rise" and dimensions of the steps on an ascending slope, if the first few strokes are directed somewhat sideways i.e. slightly under a right angle to the slope. After the step is gently sketched out some harder blows are dealt, the force is then reduced, and the roughly hewn step shaped out. The floor or tread is made to slope inwards at a slight angle, and ice-chips and snow cleared out by means of the adze.

This description must be taken as the general procedure on *ice* at ordinary angles. It must be modified to suit the always varying conditions. The first few blows will tell the experienced cutter how the ice or *névé* must be treated. The number of blows required also varies enormously, from the single sideways slash or scrape of the adze corner, to a hundred or more blows of the pick. I have frequently used much more than the last number to a single step, where the ice was between 70° and 90° in ice-falls abroad, or ice-chimneys at home.

In addition to its main function of forming the ice-steps, the pick can also be of service as an anchor or hitch on hard snow or ice. If in ice, then holes must first be dug in which to insert the pick. The adze can also be used in this manner, but this part, the

original hatchet, is now of comparatively slight importance, and does more service as balance and weight to give force to the blows of the pick than otherwise. When crampons are used it is not required on hard snow. On snow too hard for kicking steps in, they may be quickly slashed by the adze. The axe is then used somewhat after the manner of killing a weed with a hoe.

The Ice-axe on Rocks

On rocks, as a general rule, the axe is a nuisance; but there are occasions where it is of the utmost service. On all long Alpine expeditions ice-axes should be carried, and by all the party, and it is seldom correct for any to be left behind at any stage of the climb. On traverses, of course, they must all be taken, all the way.

On rocks in bad condition the axe of the leader is in constant requisition: to find and make handholds and footholds; to clear off the masking snow from the ledges; and to clear cracks and projections from the slippery ice. The axes of the followers are only less actively employed, and are very necessary anchors of safety on slippery rocks.

Besides their more strictly orthodox uses such as indicated, ice-axes have also been employed on rocks in other ways: such as to push or persuade, by the *vis a tergo* method, people up pitches who were unable, or unwilling (?), to climb them. They have also been used as footholds, the pick stuck in a crack, or the shaft merely grasped in the powerful, or otherwise, hands of the second on the rope. The pick has been hung to a ledge (*peccavi!*), and the ascent made by climbing up the shaft with the hands. All use of the ice-axe in these ways may be said to rather more than border on the illegitimate and unsafe.

Slung Ice-axes

For the purpose of freeing the hands when climbing rocks, slings are employed. These are best made of a strip of woven material such as hemp; lamp-wick makes an excellent sling. The climber who trusts to a boot-lace will sooner or later lose his axe. The sling may be fastened to the head of the axe by means of a couple of clove-hitches.

Though slings are useful and convenient for the followers, especially if these are not adepts at handling an axe, the sling is a great drawback to the leader, especially on icy rocks, or a much-mixed ice and rock arête. Cutting steps, or clearing ice and snow, cannot be done efficiently with a sling on, and it is too great a waste of time to be always taking it off and putting it on again. The climber who aspires to lead must learn to do without a sling.

It is really easy, with practice, to carry the well-balanced modern ice-axe, with its flattened oval shaft, safely stowed between the thumb and forefinger of the left hand when climbing on rocks, except the very difficult. On these the axe may be pushed up by the leader, or passed up by the second, or even all the axes of the party may be hauled up separately on a spare cord. On an " open " difficult place, the axe may be carried, passed through the waist-loop behind.

It is really safer for the party when the leader does not use a sling, if he really knows how to handle an axe.

The ice-axe, with its long beak, has a nasty way, when slung, of getting caught at awkward places, and this, whether the sling-loop is over the wrist or over the elbow. If a follower is thus forced from his hold, no harm is done; he has the rope above him. A leader must not take the risk.

How to use Crampons

Some form of crampon has been in use in Alpine countries from time immemorial. Just as, ever since the invention of the horse-shoe, or even previously, the hoofs of horses had to be sharped or muffled by their riders when crossing ice.

The ultra-modern man of motors puts on crampon studs of steel, or muffles his "fiery" steed's hooves with rope under similar conditions.

Long before the time of Simler (1574) iron crampons were in common use in Switzerland when glacier passes had to be crossed. We read of their use in the Himalayas in the pages of Herodotus, and in the Caucasus in the works of Strabo and others. In this last range I have observed an ingenious fitment of rope made by the hunters of the "tur." This they put on over the smooth raw-hide shoes worn by all the mountain peoples. Smooth-soled soft shoes have been, in fact, the foot-gear of all mountain peoples, from Scotland and Norway to the Caucasus and Himalayas. They are greatly superior on *easy* rocks and on rough ground generally to stiff, heavy boots.

The detachable crampon was awkward, heavy, and easily lost. The nailed boot was evolved. The nailing systems now in use are in reality small fixed crampons. For the purpose for which the old one-piece crampon was employed, the traverse of hard snow, and ice at *easy angles*, the modern nailed boot is more convenient and more efficient when the nails are not too much worn.

When Alpine climbing at steep angles began to develop it was probably the realisation by the pioneer guides of the great danger of using the old one-piece crampon on ice, except at very easy angles, which caused them to avoid them. None of the great pioneers seem to have worn crampons.

Nevertheless, when properly designed and skilfully

and intelligently used, crampons can be undoubtedly of great service, and they are being increasingly employed, even at Chamonix and Grindelwald, the homes of the old ice-guides.

A properly designed and comparatively light climbing-boot with sharp, unworn nails is, however, the best compromise for all-round mountaineering. In my opinion, at any rate, the Alpine climber who starts by using crampons, and employs these on every occasion, whether suitable or not, will never learn to be a safe and competent mountaineer. Their use I consider analogous to the use of *kletterschuhe*, or rubbers—excellent for special ocasions, bad for general mountaineering.

The main advantage for a party in using crampons is that it tends to level it up, and the worse the climbers the greater the advantage of crampons. For the leader or leaders, who, though perfectly competent to walk up steepish slopes of hard *névé* without wearing crampons, would nevertheless have had to cut steps for their less practised followers, crampons are an enormous saving of labour, and, for the party, of time. A party without a competent leader on ice can often manage to make an icy ascent by all employing them.

By thus permitting parties composed of people without "balance," and of slight mountaineering experience, to gain places otherwise quite out of their reach, crampons have been the cause of many Alpine fatalities of recent years. To most of the accounts of the loss of four young climbers is attached the note: "All were wearing crampons." Crampons, to these unfortunates, have been the analogues of the mountain railway, which unloads incompetents on Alpine glaciers, to there wander about, and probably to fall into crevasses.

If it is an advantage for a climber with guides, even if he has slight use for it, to learn the feel and balance of an axe before going on a high expedition, it is of vastly greater importance for a would-be guide-

less mountaineer to learn the use and behaviour of crampons on short, easy places, before joining a cramponed amateur party in the ascent of a great ice-peak. Hard spring *névé* at home, or even the easier slopes in a chalk quarry, make good practice-ground.

Probably the best place is, as with the ice-axe, the naked glacier near some Alpine hotel; but, as when learning cutting, it should be borne in mind that ice varies much in texture. Spikes quite sharp enough for the sub-snow-line glacier, may be almost useless, and extremely dangerous, on really hard ice.

The spikes of a crampon must be kept sharp. They will soon become blunted if used on rocks for any distance. After such an expedition they should be re-sharpened. This is best done, if the necessary skill is available, by "drawing down" the points with a small hammer, on an anvil or vice. The file is also effective, but wastes the metal.

Crampons take a little time and trouble to fit on and strap up. This must be done carefully and accurately. The straps should not be drawn too tight at first. As the fibres become moistened by the snow melted by the heat of the feet, the binding contracts powerfully; this may cause frost-bite, and is at least very uncomfortable. If leather straps are used they slacken when wet.

Some crampon enthusiasts have dwelt upon the ease and rapidity with which the crampons can be put on and taken off, and have stated the exact number of seconds in which these operations can be performed. These times are, however, ideal records, and little likely to be attained in ordinary practice. In fact, the straps often become so stiff and frozen up with crusted snow and ice, that it is not easy, with cold fingers, to get them off at all. At a bivouac, or even long halt, they ought certainly to be taken off. Their circulation-stopping effect is very likely to cause frost-bite in severe conditions.

The perfect crampon, to my idea, should be a set

of spikes screwed to a special boot, and should not have bindings at all.[1]

As mentioned in the chapter on "Equipment," we should see that the crampons we buy are properly fitted to the boots we intend to use, and are furnished with not less than eight, ten are better, long sharp spikes placed at the edges of the boots.

It is necessary, when walking with such crampons on, to lift the feet somewhat higher than usual, to prevent the spikes catching in the ice, and also to walk somewhat widely, to prevent them striking the boot, or catching in the stockings or puttees of the unemployed leg. When not in use, they should be placed in their tin folding protector. It is exceedingly unpleasant to sit down on them when their business ends are bare.

It is possible for the expert mountaineer, with sharp-nailed, narrow boots on, to walk up ice which is covered with an inch or two of hard snow, at an angle of from 30 to 33°. Crampons enable a steeper slope to be ascended, say 40 to 43°, above that; even at lower angles if the ice was hard, and the slope long, and above a dangerous place, I should certainly cut steps.

Somewhat higher angles are possible on short slopes where no damage would occur in the event of the cramponist losing his balance, or breaking out a step. Here we must work after the style of the ski-runner, and either adopt the "herring boning," or straddling out, method, or ascend side-ways as a young child climbs a stair.

In a certain state of the snow the crampons can become a source of danger, and this condition is the very probable explanation of some wholesale disasters which have occurred to parties of young cramponed climbers.

Such a party starts for the ascent of some steep ice-peak using crampons. The snow in the morning is hard and firm. They walk up easily, spend a long time

[1] See "Exploration," Chapter XV.

at the top, and start down again in the afternoon. The snow is now, however, soft and "balling"; they cut no steps on the ascent, and have therefore none to descend by, nor is it always easy for them to follow the line of ascent, as crampon pricks in hard *névé* soon disappear.

Presently, perhaps suddenly, "sabots," the French-Swiss term, form under the feet of one of them. In an instant he is on his back whirling down the slope. The others are probably in little better case, and all go. Another of those wholly unnecessary "Fatal Alpine Catastrophes" has occurred.

It may be said the party would stop to kick out the snow when it balled. Anyone who has had much experience with this condition, on boots, skis, or crampons, knows that on the last two it is not practically possible; it is difficult enough in boots. In this condition of the snow the crampons should be taken off, and reliance placed on the axe and the nailed boot.

The Crampon on Rocks

On moderate and easy rocks, which have become somewhat difficult and dangerous through being covered with ice and snow, crampons are of great service, more especially to the leader. His clearing task is for the most part reduced to the making of hand-holds. If, during the ascent of a steep ice arête, the party meet with a short stretch of ordinary rock work, there is no necessity to remove the crampons. On most standard Alpine routes the rock-climbing is not very difficult, and is easily done in crampons. It is rather a question of damage to the spike-points, than any advantage or disadvantage of the crampon over the boot.

When the angle on ice is really steep, and steps have to be cut, these do not require to be so carefully finished for crampons as for nails; but, as the angle increases, even larger steps are required for crampons than for boots, to give a really sound hold. It may be

an encouragement, however, to know, that the steeper the angle, up to 60° at any rate, the easier it is for a man in ice-steps, whether wearing boots or crampons, to hold safely a person who slips out of a step below him.

I trust nothing here written will be taken as meant to discourage the use of crampons in any way. I am too conscious of the great assistance they have often been to me; but the crampon, like the Alpine rope, is in some danger of becoming a fetish, to cover up bad, and dangerous, mountaineering.

We might sum up the case for crampons thus:

(1) On most ordinary Alpine climbs crampons are not required.

(2) On peaks in bad condition, and especially on rocks, they are of great service, and conduce to safety and time-saving.

(3) On long, icy, or new climbs, with only one competent step-cutter in the party, their use is essential to success.

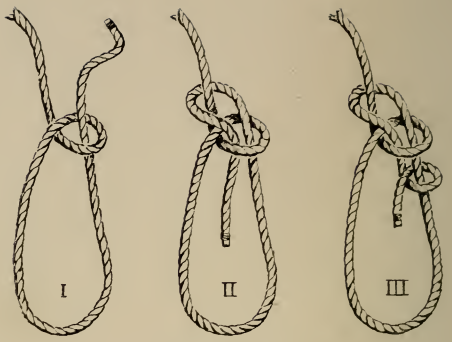
How to use the Rope

Contrary to what is often believed by the non-climbing public, the rope is rarely in constant use during a climb.

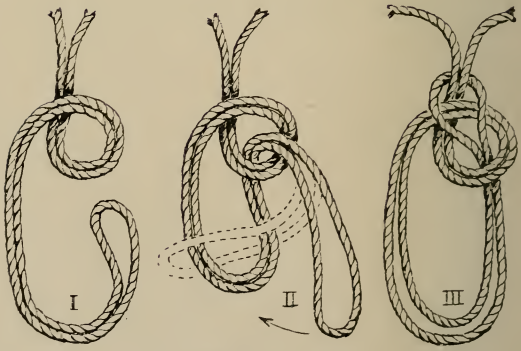
It is often a source of great puzzlement to these *how* it is used. It is easy enough, they say, to understand how the last two men can climb up the rope, but how on earth does the first man manage? If you reply that he does not manage "on earth," but, as he is always an "adept," he simply throws the rope up into the air, and then ascends it, they may think, with justice, that you are chaffing them.

Mountaineers are, of course, rock and ice, not rope climbers: the thin, hard, Alpine rope, or thinner and harder line is badly adapted for such a purpose.

By far the most important function of the rope is the conversion of a party into a single unit. The



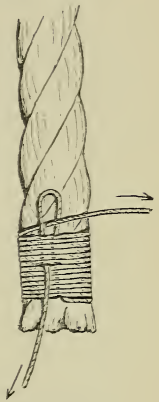
BOWLINE KNOT.



BOWLINE ON A BIGHT.

putting on of the rope is the taking out of an insurance policy. A rope will not always prevent an accident happening to a member, but, properly worked by the others, the rope should always be able to greatly limit, or entirely obviate, any ill effects of a slip or fall.

The rope also helps to level up a party. A competent leader, with the aid of the rope, can easily enable a party to make a safe ascent of a difficult climb, which none of the others would be capable of accomplishing, or justified in attempting, without him. Numerous illustrations of the use of the rope are given in the typical climbing chapters of this volume. Here are given some general instructions and hints how to care for, handle, and employ a rope on a climb.



WHIPPING.

The rope, when new, will be found to kink badly when wet. This is a troublesome trait, but is really the sign of a good rope.

It should be stretched, but the stretching must not be overdone so that all the liveliness of the rope is lost. If the whipping comes off, or if for any purpose the rope is cut, see that the loose end is whipped promptly, otherwise a lot of the rope will become unwound and spoiled.

Do not be satisfied with tying a clumsy, ragged knot on the end of the rope; this looks very slovenly, and will always be in the way. No permanent loop or knot should be on the rope at all.

To Carry

The most convenient shape to carry a rope is in the form of a coil or wreath. The head and one arm are thrust through the wreath, and it is hung on the opposite shoulder.

The method of making the coil which gives the correct size is as follows : The man who is to carry the rope sits down, and the rope is coiled with the lay, under the instep and over the knee. When all is coiled, except about four or five feet, the loose end is then twisted with the lay, and wound spirally round the coil, holding it firmly together, and binding in the other loose end left at the beginning of the coiling. The wreath is then secured by taking about half the coil's thickness, and finishing off with a clove-hitch.

Another way of carrying is *en boudin*, a favourite method in Dauphiné. The rope is made up in the way clothes-ropes are sold, and hung over one shoulder by the last loop.

Still another is in a chain of loops which all run out on the final one being unfastened.

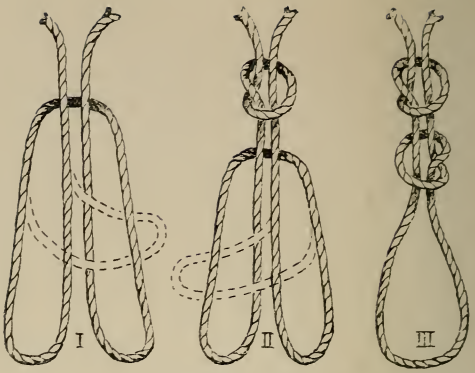
On taking down a rope for active service, it will save time and considerable annoyance if the binding-in portion is *completely* uncoiled first. If even one fold crosses, tangles are probable, especially with a new and lively rope.

If two ropes have to be joined at any time, this should be done with the fisherman's, or the figure-of-eight knot; these weaken the rope least.

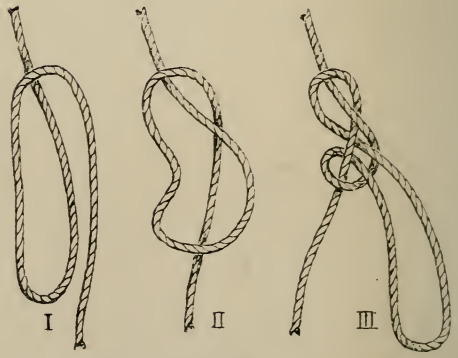
Two parties should never, on any account, be joined up by fastening the rope of the second party round the waist-loop, or the waist, of any following member of the first.

These methods do not really convert the parties into one. They take away from the leader of the first party his rightful and dutiful control over the rope, and pass it round what may easily be the weakest member of the whole. He is now the real leader of the second party, or, more properly perhaps, a midway hitch or " belay."

An absolute rule should be : " All central members in a climbing party, whether on steep ice, on rocks, or on a snow-covered glacier, should lie in a loop of the rope, and off the direct line of strain from either end."



MIDDLEMAN KNOT.



MAN-HITCH, OR HARNESS KNOT.

If this is not done the leaders risks are not only transferred to the "Piton," but are aggravated. If he is on the rope with a fisherman's or middleman's knot, this normally "running knot to hold" may act as a slip-knot. A slip or fall otherwise almost innocuous, may result in severe internal injuries. If he or the man in front or behind both slip into a crevasse, or are in suspension on a rock face, and he is the higher, the lower man cannot be hauled up without transmitting the strain through the "Piton's" anatomy.

Knots

Only a few knots are commonly used by climbers, and these are of the simplest. It is rather surprising that so few mountaineers care to take the small amount of trouble necessary to learn how to make them. It is, of course, by no means easy to learn "knotting and splicing" from diagrams, a few lessons from an old sailor or fisherman make the methods employed clearer. An endeavour has here been made to show, in the diagrams, how the ropes run in forming the various knots.

Bowline.—This is the best knot to use for end climbers. It is quickly made, simple, and never jams, so is very easily undone. It is rather apt to work loose. This must be prevented by taking a half hitch, as shown, or an overhand knot.

Bowline on a Bight.—This is the same knot as the last, but formed in a loop of the rope: the best knot, in my opinion, for "middlemen," especially if less robust than usual. Also the best knot for a party of two. Three other knots may be used for middlemen.

Fisherman's, or Middleman's Knot.—The knot has been condemned for the reason that it partakes of the nature of a slipknot, or noose: this is quite true. In actual practice, however, I have seen it used many hundreds of times; I never once saw it show any tendency to act as a noose The only way, I think,

it might be caused to act thus, is if the rope of a following party were to be fastened to the waist-loop of a middleman. This is utterly wrong for several reasons, and should never be done.

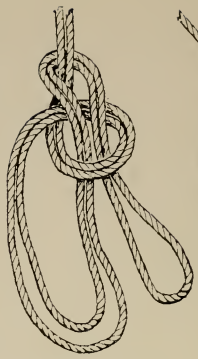
Man-hitch.—Called also a harness-knot. It is a military loop, and, as the diagram shows, extremely simple. I have not had any experience with it in climbing. Probably it would work loose too easily.

Overhand.—A knot almost always used by guides for middlemen climbers. It is very easily tied. This has been condemned as a bad knot by some authorities. Others have said that its survival proves that it cannot be a bad knot. A point against it is that it weakens the rope more than the other knots. It certainly does not slip: its chief fault, in fact, is jamming. After a day in wet snow round a heavy body, it is often a matter of great pain and labour to get it off at all. Sometimes this proves impossible, and it has to be cut. For those climbers possessed of an isthmus I consider it an unsuitable knot. For the middleman of geodetic figure, whose torrid zone is his greatest circumference, difficulty of extraction will, of course, not arise.

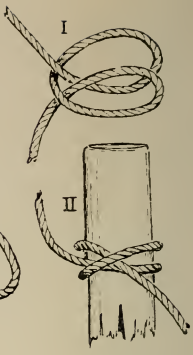
Clove-hitch.—May be described as two jamming half-hitches. It is exceedingly simple, yet holds in a marvellous fashion, and at the same time is most quickly and easily undone. It is useful for hoisting ice-axes, either singly or in bundles, for holding securely the rungs of an improvised ladder, or for making a stretcher for an injured person. It is made with either a bight or the free end of a rope with equal facility.

Triple Bowline is an ordinary bowline made on a doubled rope. It is by far the best knot to form loops for the carriage of an ill or injured person. If it is at all possible to avoid it, no one who is at all injured should be hauled or suspended by a single loop. The triple bowline gives three, and these can be adjusted in length to suit, say, one under the arms, one under the hips, and the third under the knees.

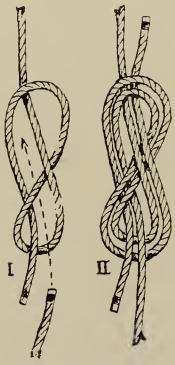
OVERHAND KNOT.



TRIPLE BOWLINE.



CLOVE-HITCH.



DOUBLE FIGURE-OF-EIGHT KNOT.

SHEET BEND.

FISHERMAN'S JOINING KNOT.

Knots for Joining Two Ropes

Fisherman's Joining Knot.—The same knot as the middleman, but made with free ends of rope. This is the handiest joining knot for the climber: it is easily made, weakens the rope very little, and also unfastens easily, yet at the same time is secure. Security can be doubly ensured by taking half-hitches with the free ends; but, if these are not left too short, and the two sliding-knots are pulled up tightly against each other, this is not really necessary.

Double Figure-of-eight Knot.—This is a very secure knot, but more difficult to make than the last, and is, when made, somewhat large and clumsy.

Sheet-bend.—A very simple joining for temporary purposes, such as sending up a spare rope or line, fastening a climbing-rope to a thick fixed rope, and so on. It will hold still better, and be less liable to jam, if the straight rope's end is passed twice round the loop before the hitch is made.

N.B.—The reef-knot should never be used for climbing purposes. It is really a slipping knot. This becomes very apparent if we seek to unite by it two ropes of different thicknesses.

. . . . .

If one wishes to realise the difference between suspension on a single loop of Alpine rope, or on two, the bowline on a bight, or three, the triple bowline, let him make the following experiment.

First put on a single bowline loop. Now pass the rope over a strong door, and stand on the toes, drawing up the rope tight. Put a wedge under the door for the sake of the hinges. Now pull up the legs and hang in the loop round the waist. Few will endure this for much longer than one minute. Now try again with the bowline on a bight, or, better, the triple bowline. With the latter, one might almost go to sleep as in a hammock; that is, if *very* tired.

Handling Ropes

Ropes on glaciers and easy places do not give much trouble, even with novices, and when new themselves. The only points to observe are that each member keeps his distance, and takes up his part of the rope when shortening it, carrying it in coils in the left hand, so as to keep it from getting sodden, wet, and disagreeable to handle. On rocks of some difficulty the new rope will often develop a certain liveliness when it perceives it has novices to deal with. It will catch at every jutting rock, it will get under and pull down loose stones. It will even coil itself round the body, arms, and legs of the climbers, till, as someone has put it, the famous group of the Laocoon is irresistibly suggested.

The reason of this behaviour is simply want of attention on the climber's part.

At first, when climbing places of any difficulty, the mountaineer requires all the attention he has to bestow, devoted to the holds for his *hands*, and feet. With practice it becomes easy to manage with less handhold : the rope can be looked after as well. One of the chief advantages for the novice climber, of a party of three, consisting of himself and two good guides, or friends, is that he then does not require to look after the rope, but, if he always continues to climb in this manner, the probability is that he will never learn to do so. If a party consists of only two, both must look after the rope. A dangerous, clumsy way of shortening a rope, yet one, it would appear from photographs, which is often done by guides—I have seen it done by Dolomite guides—is for the leader to coil the portion not required round his shoulders, and then hold the rope in his hands. The correct method is for the leader, or last man, first to untie, then put himself on the rope again with a middleman knot, leaving the portion not required as a free end to be coiled round his shoulders.

Eric Greenwood.

BELOW THE S.W. BUTTRESS OF THE SCHRECKHORN.
LOOKING AFTER THE ROPE

A. E. Robertson.

CENTRAL COULOIR, LUI.

Thus the hands are left at liberty, and the rope does not get in the way.

Doubling ropes is not advisable. It is then very difficult to prevent them catching, and, generally speaking, the trouble of looking after them is much more than doubled.

The climbing up of ropes has been dismissed as not practical politics for mountaineers. There are no fixed ropes to my knowledge in the Alps, where more is done than use these as aids in climbing up the *rocks* ; and the same holds good for descents.

There are many places, on very difficult climbs, where a rope may be employed to secure or aid the descent of the last man of a party. "*Abseiling*"—by which I mean the descent of overhanging places by the rope alone—is very rarely necessary, and is, perhaps, a doubtfully legitimate method of mountaineering. Not that this method is difficult in itself. An absolute ignoramus at climbing, who is something of an athlete, will find no trouble in descending even a loose rope, and of course, if the rope is long enough, it can be made double, and held by the others below. If the distance is short it is sufficient to grasp the rope with both hands, and coil it once spirally round the thigh. If higher than a dozen feet or so, an easy method is to pass a loop over one foot and stand on this, bringing the rope up the front of the body, and over the shoulders below the coat collar. This takes nearly all the strain off the arms, and transfers it to the leg and shoulders.

As mentioned above, this sort of rope-use will very rarely be found necessary. The traverse from the Grand to the Petit Dru is sometimes cited as a climb involving a descent of this kind. This is not so, however. The *Cheminée en Z* on the north-east edge of the higher peak can be descended in the usual way in which such a steep rock and ice-chimney is managed.

It may be said that the best climbing-party, and the best climbing, is where actual need of a rope is experi-

enced least. Yet aid from a member above to one below him, is often very easily given, saves time, and the lower member's strength, and, if it is to the advantage of the whole party, should not be lightly refused. Especially for the last man, who is probably the heaviest loaded, is some slight assistance from the rope due, to put him on fair terms with the others. The generally short reach, and weaker arms, of ladies and children, should also have full consideration. Usually a quite small amount of tension on the rope, " holding," not " pulling," will be sufficient.

The rope's main function is always the prevention of a slight slip or loss of balance from developing serious consequences, and for this purpose constant vigilance and care on the part of everyone is all that is required.

Ropes should be examined after every climb for injuries. If a new rope gets damaged at one place it may be cut through, rewhipped, and used in two portions or repaired with a long splice by an expert. If well done the repaired rope will still possess 90 per cent. of the strength of the old, and will pass through a ring, or over a block-pulley of the same size as before injury.

Ropes should not be put away in a close place when damp. The following incident may help to point this moral.

My rucksack, containing boots and a very wet rope, was taken away by mistake by another climber at a climbing-meet, and I did not get it back for ten days or so. The rope seemed then dry and all right.

About two months afterwards, I was showing a friend some sea-birds' breeding haunts on cliffs about 200 feet high. As he wished a few guillemot's eggs, I put a walking-stick into the turf, looped a rope over it, and prepared to descend. In fixing the rope I bent it sharply, when it at once broke half-way through. It proved to be thoroughly rotten, and unable to bear a strain of more than 50 pounds.

All vegetable fibres are very easily attacked by

mould fungi. This is probably the reason why the St. Kildan bird-catchers, in their very damp climate, preferred ropes of twisted horsehair.[1]

A climbing-rope should therefore be left loose, and not be put away until thoroughly dry.

For convenience of measurement, it is a good plan to mark the centre of one's rope with a small piece of waxed string, or very narrow silk ribbon, passed through one of the strands.

I have hitherto dealt with the physical uses of the rope for mountaineering. The rope's use is very much more important than that. It is the physical sign of the thread of will and mental effort which connects the members of a roped party, and of them makes a single unit. The "moral" assistance of the rope has been spoken and written of in a half chaffing manner; its moral assistance is very real. Its putting on puts, as it were, everyone on their mettle. The leader's responsibility may be greatest, but the rope distributes part of this responsibility among every member, while at the same time giving just the confidence and courage required, to enable the less practised, or more diffident climbers, to do themselves justice.

The best definition which I can give of this use of the climbing-rope is, that in a moral and physical sense the rope represents *l'esprit du corps*.

[1] *St. Kilda*, by Norman Heathcote.

CHAPTER XIII

SOME TECHNICALITIES

"La meilleure mesure d'assurance contre les dangers c'est la connaisance de la technique Alpine."—MAURICE PAILLON.

SOME students of mountaineering may have wondered why, in this volume, I have not devoted a long and detailed chapter to the "Dangers of Mountaineering." These have been treated of very fully by some writers, indeed whole volumes on "The Dangers of the Alps" have been published in various languages, as well as many articles. It would almost seem as if some of the writers on this theme were inspired by the motive which moved the famous "fat boy" in *Pickwick*, "I wants ter make yer flesh creep."

For the causes of the accidents, which they love to recount with so much wealth of detail, they usually blame everything but the fundamental cause.

Some will declare, "It was, of course, because the party was without guides," or they blame the rashness of youth, climbing under bad conditions, and so on. In reality, however, the vast majority of accidents are not due to any of these superficial, accessory causes, but to ignorance of climbing technique.

In putting a disproportionate emphasis on mountaineering dangers and accidents, I think these writers made a serious mistake.

The youthful climbers of Britain, her Colonies and Dominions, and of America, are at any rate of sufficient independence of mind to resent the low estimate put upon their reason and common sense by this undue

dwelling on and pointing out of what, after all, are very obvious dangers.

As Koheleth said, it is not in youth but in later life that we most dread "that which is high." For the youthful climber who soon overcomes his first fear of that which is high, a knowledge of climbing technique is the very best accident insurance policy, and, unlike ordinary insurance policies, its benefits are preventive and anticipatory, and not merely retrospective and palliative.

The continual harping on the danger note tends also to defeat its own ends. The youthful climber, after a first season in the Alps, with guides, when not a single dangerous incident, such as he had been led to believe was inseparable from the sport, had occurred, is apt to rush to the other extreme. He is apt to think, with Tartarin, that climber's tales are, like the proverbial traveller's, to be taken with more than a grain of salt. Thus the opposite effect to what the writer intended, the necessity of care and training, may be produced.

The technique of mountaineering means the practical application of the principles of mountaineering art, and of course cannot be learned except by practice. An endeavour is made in this chapter to bring together, discuss, and illustrate a large number of "pointers" on mountaineering technique.

Mountaineering Balance

Balance is the supreme characteristic of the "compleat" mountaineer. Without it no man, whatever his list of peaks and passes, is entitled to be called a good, that is, a safe, mountaineer. His position on the climbing-rope should always be between two good guides, or skilled friends. If he is allowed to lead accident is invited.

It is difficult to explain exactly what is meant by balance. It has nothing to do with the ability, say, to

look down unmoved from such a position as a window-ledge. It does not imply immobility. It rather denotes an unusual quickness of brain telegraphy, and a corresponding rapidity in the execution of orders by the muscles and limbs.

It is well known to surgeons that people do not sprain their ankles when they are looking for this to happen, say in walking on steep, rough ground. The reason is, that special watch is kept by the brain over the ankle muscles. In mountaineering balance, all the muscles are on the *qui vive* all the time.

At first the watch is kept consciously by the higher powers of the brain and nerve-centres. This is the real cause of the disproportionate bodily and mental fatigue felt on a difficult climb by the novice, even though a much more powerful man, and doing far less work, than his experienced leader.

With practice, the control is largely turned over by the higher brain-powers to the lower or sub-conscious. These do not suffer to anything like the same degree from fatigue.

It might thus seem that " balance " is nothing but practice. This is not so, however. A certain degree can be acquired by practice.

The highest rank as mountaineers can only be attained by those who have added persevering practice to natural innate ability. A man with innate balance can become a first-rate, safe mountaineer, though he never sees a hill before the age of thirty or more, while a man wholly without the natural quality, must practise long and hard, and even then will never rise beyond second-class. Though the movements are so different, yet skating furnishes the closest analogy to mountaineering, and the above remarks apply with equal force to both sports and modes of travel.

Skating is the best training for the would-be mountaineer. Its main secret is the same. The acquisition of the power of altering the balance quickly in any desired direction without losing control of it. It

follows that a good skater, or ski-runner, is already more than half a climber.

Sure-footedness

A stumble means a loss of balance, clumsily recovered, with a loss of time, and an enormous expenditure of energy.

A practised mountaineer hardly ever stumbles. If he does happen to make a false step, through a stone turning under his foot, or such-like, he does not struggle against the temporary loss of balance. He accepts it, and hastens to correct it by yielding to it, usually in the form of an increase in pace. He treats the erring foot as out of action, and drags it after the other till it is swung in front again. Usually the even flow of the walk or run is hardly interfered with.

Professor John Ball, F.R.S., in dealing with this subject in the preface to the *Alpine Guide*, writes: "Sure-footedness consists in two things: firstly, in observing the spot where the foot is to rest; and, secondly, in bringing it down at once."

With the first of these conditions I am in accord, if we add that the observation must be well in advance, and be automatic. If the observation is a forced one it will not result in true sure-footedness. The moment the attention is diverted, say by conversation, stumbling is liable to occur. The subconsciousness must be in charge, leaving the higher free for other things.

With the second I am wholly in disagreement. It is just the ability not to *have* to bring the foot down at once which constitutes mountain balance and the sure-footed person.

As in skating—though in walking this is, of course, very instantaneous—the mountaineer is really balanced on *one* foot, and should have the power of dealing with the unemployed foot in any way which may suit the case and the balance best.

A supreme example of mountain balance is given

by the chamois. When caught in a difficult place among rocks, I have seen this graceful little antelope do marvellous "banking turns," by springing sideways against almost vertical rocks, almost like a billiard-ball off its cushion. When a guide calls his employer a "chamois" it may not be out of a desire to flatter him. The guide may recognise that his Monsieur has the innate balance which he knows is highest developed in the little animal.

An expert on mountains will run lightly and easily *across* a tract of boulders, keeping on the surface as it were, which the novice will only pass through with slow pace and many stops and restarts. The expert may disturb stones; this does not worry him. Long before the stone has made up its mind to move, his weight has been transferred to another stone and another foot: what the stone left then does is of no consequence. A similar principle is utilised by the balance mountaineer in crossing a torrent in which boulders project at six-feet intervals. A pause on any one boulder would probably result in the boulder upsetting, or the traveller losing his balance, with wet results in either case.

The supreme importance of balance is best brought out in mountaineering on new peaks, and on the grandest scale.

In the comprehensive rule for mountaineering which will be found in the chapter on "Ethics and Rules," conservation of energy is mentioned as the first and most important part of mountaineering. The power of this conservation is to a very large extent dependent upon the acquiring and possession of mountaineering "balance."

The Mountain Walk

The ideal bounding step of the mountaineer is, as a fact, only exhibited on the descent. The best style up-hill is not a graceful one. It is a kind of roll from the hips, from side to side. The feet are planted flat.

Using the toes is avoided as much as possible. The feet are not lifted, but dragged up alternately. Zigzagging pays best in the long run. Of course the young and the unburdened may often find it easy to mount directly up a slope, which another, loaded down with a heavy rucksack, or, worse still, the "howdah"[1] of forty or fifty years, finds too steep for him, but it is well to bear in mind that, in cycling phrase, the gear should be lowered as the angle increases. Shorter steps ought to be taken, the rate of stepping should be decreased. Otherwise we may be mounting twice as fast, and of course putting out twice as much energy, in the same time, and it is an old and a true saying that it is pace that kills. The Italian proverb in this connection is the best known: "Chi va sono, va piano, chi va piano, va lontano." Similar phrases of proverbial philosophy occur in other languages.

Zigzagging not only eases the gradient and allows a steady uniform pace to be kept up; it also best distributes the strain over the muscles employed.

Some start hill-climbing on the rush-and-rest system. They will find this twice as exhausting, and no faster in the end, than a steady, somewhat slow, even pace, with few or no halts whatever. The great secret for a party of mountaineers engaged on a long, hard climb is to make the pace not too fast for the slowest and weakest member. As a rule, therefore, the larger the party the slower it is. This does not only apply to difficult rock-climbs, but to everywhere on the heights, except where deep soft snow is encountered, when the killing task of leading can be wider spread.

[1] The Rev. John Jackson, of Whitehaven, an enthusiast of the Pillar Rock, in Ennerdale, Cumberland, and who climbed it alone, in 1875, at the age of eighty, wrote some verses commemorative of the expedition. The following verse shows a wit as supple as must have been the old gentleman's limbs:

> "Two elephantine properties are mine,
> For I can bend to pick up pin or plack,
> And when this year the Pillar Rock I climb,
> Four-score and two's the howdah on my back."

An alpenstock, or ice-axe, if the latter has *not too short a shaft*, is a very considerable help in walking on steep slopes of any kind. In ascending, the hip and thigh muscles can be relieved by transferring a certain amount of the load to those of the shoulders and arms.[1] The ultra short-shafted axe will here exhibit its real useless, not to say dangerous, character. Fully 90 per cent. of mountaineering is done at moderate angles. The most important rule of climbing and walking on any slope is, "Stand up straight." The man who uses the short axe will not do this; he will be in traverses and descents, frequently off his balance, leaning towards the slope. He will fall often, or put enormous strains upon his arms. He will, in fact, be forced into the attitudes of the bad and timid ski-runner, or the duffer glissader.

In traversing and descending, we hold the shaft more or less horizontally against the slope above, and can arrange the balance so that there is never any chance of falling down-hill.

It is, as a matter of fact, not easy to fall down-hill. If we slip we really fall up-hill. The only way in which falling down-hill on a slope is probable is if, while going fast, we get a toe under a projecting stone which is fixed. This may result in a bad fall. The small bone of the leg, the fibula, is apt to break under the sudden strain. I remember, years ago, taking a heavy toss from this cause, which partly from good luck, partly perhaps from Rugby football training, resulted in not the slightest damage.

I was running rather fast down a steep hill-side, Glyder Fach in Wales, when my toe caught as above, but only momentarily. As I flew into the air, I tucked in my head and curled up, and, alighting yards below on my shoulders, whirled round, and was on my feet and running rather faster than at first before I had quite realised what had happened. Next to skating, perhaps Rugby is the best training for

[1] See Chapter II. p 22.

J. R. Young.

A STEEP ANGLE. DOLERITE.

R. Adam.

A SLABBY PITCH BASALT.

mountaineering; at any rate, the work of the halves.

The axe may occasionally be used in front when jumping down, from rest to rest, some small rock or steepish place; but, as a rule, the axe should be behind one in going down-hill.

In descending it is often easier, if the slope is steep, to run. This applies especially to steep grass, to snow just not steep enough to glissade, and to small scree.

For a quick, easy descent, nothing beats fine scree. It is best descended in long cantering bounds. Here the landing shock is so much softened, both by the looseness of the material and by its running away on receiving the foot, that it is little felt.

The run, of course, must be continuous. A slip or incipient stumble must be, as it were, caught up by increased pace.

On Climbing

Climbing up Rocks.—It is natural, when climbing is mentioned, to think of climbing up. We also climb up trees, and, by the way, tree-climbing is excellent practice for the mountaineer. Here, as on rocks, the legs do the greater part of the work. This is the great difference between man and the monkey on trees. At the top of our tree we cannot, as a rule, walk away easily, we must again climb down.

We are always told by climbing authorities never to climb up into a place from which we cannot descend, and we occasionally hear of adventures and accidents happening to youthful climbers who have got themselves stuck in this fashion.

The advice will not be required by, and the position will not occur to, anyone who practises climbing down as much as he does climbing up. In climbing up, the holds, especially small flat ledges, appear to be better than when climbing down. In reality, such a hold

rapidly decreases in security as the weight is drawn up level with it. On the descent, of course, the hold improves, and much less force is necessary.

There is comfort and confidence to some, in climbing up, from having the face and body close to the rock. The vision of the depths can be at will shut out. The hands, the members of more trained intelligence, come first in contact with the holds, and seek the route. The feet have only to follow their lead, and can at a pinch be dragged up by them. On the whole, it must be acknowledged that, for the inexpert, non-leader mountaineer, climbing up is the most attractive, simplest, and easiest. It does not follow that for the expert, or that in fact, it is really the easiest.

Climbing down.—It is quite a common thing for Alpine and other climbers, of long and wide experience, to hold that climbing down is more difficult than climbing up.

The reason for this belief is, that almost all those holding it have been accustomed to occupying second, third, or non-leading positions on the rope, have always had a rope above them at really difficult places, and are therefore not competent to judge properly. Those leaders, if any, who hold the belief, would seem to exhibit the fact that their training in climbing has been one-sided. They have almost always done their climbs up.

In reality, for the expert, climbing down is easier, much quicker, and very much less fatiguing. If the climb is steep and difficult, climbing down is also much safer, as a rope can be used for security.

A point which has perhaps tended to obscure the relative difficulty or ease of certain long and hard rock climbs in the Alps is this. A good guide can safely conduct a party of two strong, active amateurs up such a climb. He, however, declines, saying, "The descent is too difficult." He does not mean for himself: he really means that he cannot steer the two amateurs on the descent, and he knows that this would

R. Adam.

DESCENDING A CHIMNEY. BASALT.

mean a night out, from the inability of the leading amateur to find the way.

It may be said that, granted the actual climbing on the descent is easier, yet descending is more difficult from the greater difficulty of finding hand-holds, foot-holds, and the way.

For a real expert these reasons do not hold good. He will pick up or recognise the descending equally well with the ascending route. If the pitches are very steep, with scanty holds, it is very easy neglecting these altogether. It is quite easy letting a man down with a rope. It is an almost impossible task for one man to haul up another any distance.

Face in or out on the Descent.—This is a question on which it would be foolish to dogmatise; it entirely depends upon the skill of the climber, the nature of the place, and the kind and quality of the rock.

Face in, on all really steep places, and where perfect confidence in the footholds is not felt, is the best rule to follow. It is much slower, and involves harder work than the facing out, but for the ordinary climber is much safer.

The death of Emil Rey of Courmayeur, one of the finest mountaineers who ever lived, occurred through his jumping down, face out, a small, easy place on the rocks below the Aiguille du Géant: but in this case the accident was almost certainly due to the boots worn. These were furnished with three long spikes in the heel, which would certainly get blunted and dangerous on rocks.

Traversing.—A traverse is usually done when the direct route becomes impossible, or too difficult. Traverses, therefore, as a rule, though they may be technically quite easy, are often sensational and trying to unaccustomed or nervous climbers.

This is the reason for the entirely false reputation for extreme difficulty which attaches to some easy traverses on certain Dolomite climbs. For instance,

that of the Kleine Zinne, or the "Thumb" route on the Funffinger, or Cinque Dita. The rope on these cannot be held, or hauled, from above. The apparent danger is therefore great, on these traverses, to the novice.

One is advised, when beginning a traverse, to note carefully the foot with which to commence. The advice is sound, but of little use except for extremely short passages. It is usually quite impossible to tell what is the best position of the feet for more than a step or two, and the best position for six-foot A may quite easily be impossible for short-legged five-and-a-half B.

The huge, wide, clumsy boot by which the climbers who gave the advice were handicapped, probably influenced them. The modern rockman in light, narrow boots, finds it quite easy, if any finger-holds exist at all, to change the position of the feet by means of a slight, almost imperceptible jump.

The man who can stand easily on one foot and move the other freely in any direction, without losing his balance, or having to grip tightly—figure-skating is perhaps the highest form of this—will find, once he is free from the mental dread of heights, most ordinary traverses quite easy.

There are, however, in the latest developments of rock-climbing, especially in the English Lake district, certain traverses so difficult, that I consider no novice should ever be taken over these, and they should never be led, at any rate, in nailed boots.

Hand Traverses.—It is no doubt possible for abnormally athletic climbers to cross a short rock passage by means of the hands alone, the feet and legs being merely passengers. On none of the "hand traverses" which I have met with has this method, fortunately for me, been necessary. A great deal of assistance for the arms could always be obtained by making the lower limbs do quite a lot of the work. The enormous value of the tiniest toe-scrape is quickest and safest

R. Adam.

TRAVERSE, SIDE-HOLD ADHESION. BASALT.

learned in bouldering. If the rocks are at all hard and slabby the nailed boot should come off at a hand traverse. Again, the warning may be given against *double* stockings on smooth rocks.

Holds and Hitches.—It is the presence or absence of adequate, reliable holds and hitches which makes a climb difficult and dangerous, or easy and safe. Angle is really of minor importance, though the fatigue involved, and, as already mentioned, the moral effect, cannot be ignored.

It is when the leader is making his way up rotten rocks that the greatest care and attention must be paid by the followers to obtaining secure hitches, not only for his sake, but for their own.

The climber on rotten rocks should "liquefy" his muscles and his movements, like a cat on broken bottles. His style should recall that of Agag, who, it is related, "walked delicately."

A number of English rock-climbers have argued that the hitch taken by the second man should be behind him, that there should be a "clear rope" between him and the leader. I cannot agree with this. If the position is such that the leader has a clear fall of eight or ten feet should his holds give way, then the result of the "clear rope" method would be the probable loss of two men instead of one. I think a hitch, not a "belay," should be in front of the second man. The leader's rope should be laid over the hitch, it should *not* be "belayed." The sea term "belay," has often been used quite wrongly by rock-climbers. It is an incorrect description of the hitch which should be used for a climber who is moving. It is quite legitimate to secure a second man by a belay behind him; the leader's rope must be free to run out a certain distance over the hitch to take off the abruptness of a check, and assist the life or elasticity of the rope in mitigating the shock of a fall. It follows, from this, that the leader should always have a somewhat longer rope than will just allow him to finish a pitch.

The second man should always keep some rope in hand to run out as described.

The hitch taken should not be too acute-angled. It is quite easy, with finger and thumb of one hand, to keep in suspension a twelve-stone man, whose rope is laid loosely over a sharp-angled hitch, if the hold be taken some distance below the hitch. It is really the hitch that supports the weight.

If a man's weight falls from a few feet above a hitch of this kind, and the rope is tightly held or belayed, the rope may be cut as if with a knife, especially if somewhat old, stretched, or of woven material.

Most excellent hitches can be got in turf ledges, especially if these are *slightly* frozen, by means of an ice-axe shaft.

The turf is then the equivalent of good hard *névé*.

Completely frozen turf [1] is very difficult material to deal with. Ordinary summer turf often gives very reliable hitches. A large gully-knife, if well driven in, slanted slightly backwards, and placed *some distance from the edge* of a cliff, will support a rope with the whole weight of a man on it.

Here, again, it is not so much the knife that supports the load; the slanted knife directs the real pressure on to the turf.

It is a safe maxim for leaders, and for all climbers, to act on: "Never trust a single hold anywhere." One should always be able to feel that, should a handhold or foothold give way, at least two others are secure.

A loose hold is not necessarily to be avoided; it may be impossible to get up without using it. Whether the loose hold stays in place or not greatly depends upon how it is handled.

It is exceedingly difficult to explain how loose holds should be handled; cases vary so much. Generally one might say, "Suaviter in modo, fortiter in re." "The iron hand in the silken glove." No abruptness; no jerks. "Tickle" the hold as you would a trout.

[1] See p. 212.

Nearly all loose holds will stay in place if pressed down; therefore all pulling out must be carefully avoided.

Holds such as turf, heather, and grass tufts, so common on *new* British climbs, have been condemned as hopelessly bad and unreliable by many Alpine authorities in the past.

These, however, can be used safely, and there is quite as much art in doing so, as there is in judging the condition of doubtful snow on the great peaks of the world.

Much climbing on oft-travelled routes is apt to induce a certain carelessness about holds. This is one of the drawbacks to the proper training in mountaineering on many of the Lakeland, Welsh, or even Dolomite climbs. These routes have been gone over so often, loose stones have all been pulled out and thrown down, every hold is so tested and so secure, that too easy a mind as regards the safety of climbing on really steep rocks is apt to be induced. Nearly all these "courses" are very much easier and safer than when first done.

On a few climbs, both at home and abroad, the case has been reversed. Two of these may be instanced: one in Cumberland, the Napes Needle; the other, the third long chimney on the Grépon above Chamonix. Here years of scraping by iron-shod boots has made these ascents decidedly more difficult by removing the original roughness of the sloping footholds.

Holds and hitches in snow and ice are generally made by the ice-axe, either using the weapon directly, or they are made by one or other of its working edges.

Perfect hitches are obtained in hard snow [1] at any angle it will lie, by means of the well-driven-in, slightly-slanting-up-hill axe-shaft.

Fairly good hitches can be obtained on ice, by laying the rope over the pick, which has been stuck in a hole cut for it in the slope above, about level with the waist.

[1] See Chapter VI.

It is, however, better and safer to use the spike here, and treat the axe as a prop or strut, and not as a tie; that is if the angle is below 60°.

Absolutely strong and reliable holds for hands and feet can be cut with pick and adze in British *névé*, also in Alpine hard snow. In ice also good footholds and handholds can be cut, but the labour is long and hard.

Handholds in ice require very careful cutting, as they must be made with a deep inward slant, and the edge is very apt to be destroyed by any impatience towards the finish.

The manufacture or enlargement of a single foothold on a rock-climb, has sometimes rendered a passage possible, or much easier, which was previously impossible or very difficult. Two well-known instances of this are to be found in the English Lake district, the "Collie Step," in Mossgill, on Scafell, and the exposed step down, round the corner from the blocked chimney, on the "New West" climb, on the Pillar Rock, in Ennerdale. Neither of these places should, however, be treated with levity. I have seen a man come off the former, and though, with a rope, the consequences were merely unpleasant, they might easily be serious. It is also true, that I have twice seen ladies leading on the second of these places, with smiling nonchalance, but both were experienced climbers, with *small feet and neat boots.*

Artificial Climbing Aids

We cannot, I fear, utterly condemn these *en bloc*. Some purists might say that a helping hand extended to a less experienced friend on a simple, ropeless climb was artificial aid to him.

Some fanatic devotees of the Alpine rope might be scandalised if it were hinted that the Alpine rope itself was often a very obvious artificial aid.

R. Adam.

A VERTICAL POSE. BASALT.

The more generally considered artificial aids are, however, those which have been tried in order to get the first man past a difficulty.

In olden climbing times it was often customary to carry ladders or long poles, in order to make bridges over crevasses or *bergschrunds*. These devices are still permanently employed in certain frequented places: for instance, on the route up to the Grand Mulets Hut on Mont Blanc. Ladders have also been tried, and used, mostly the former, on rocks—notably in the long siege laid by Mr. Dent and his guides to the Grand Dru.

Peaks inaccessible, or supposed to be so, have been lassoed, attacked with crossbows,[1] and rockets, by mining out and fixing of permanent iron stanchions,[2] or, more simply and cunningly, the guides, after mining holes, have used removable pegs of iron, so that they may keep their peak locked till the admission fee has been paid.[3] In most of these cases these methods have proved unnecessary after all. The Aiguille du Géant can be climbed on another side without touching the iron bars, or the ropes with which it is so freely festooned.

A great deal of time and energy has sometimes been employed by a party in endeavouring to throw a rope up to catch on some projection above, with or without a stone attached. This has occasionally proved successful on short pitches. It is a very dangerous method, as it is impossible to make certain that a rope caught thus will still hold when the angle of strain becomes altered as the climber hauls himself up.

Mr. Whymper describes a device for thus projecting a rope above the climber. It consisted of a kind of grapnel, or claw, which was to be pushed up on the end of an alpenstock and dropped on a ledge, or into a crack. The climber was then supposed to swarm up

[1] Aiguille de la République, Grand Charmoz.
[2] Aiguille du Géant, above the Mer de Glace.
[3] Pointe de Lepéna, Pralognon, Tarentaise.

the rope. It seems impossible to make out that this was ever of any practical value. In any case, it must be remembered that Mr. Whymper's knowledge of rock-climbing was, at the time, of the most elementary character, and that he never ascended any rocks which would have given pause to a modern rock-climber, climbing without artificial aids.

Most of these methods of artificial aid are, fortunately for the sport, fatiguing and futile, when not actually dangerous, and are seldom resorted to nowadays.

It is quite legitimate to carry a piton for securing the last man on the descent of any extra steep place.[1] It may be of use perhaps once in twenty years, on home or Alpine climbs. It is usually better and safer, if a natural piton cannot be utilised, to provide for security by means of a rope-ring, which can be quickly made out of a piece of the reserve cord.

Sensational bits of work have been carried out on certain steep Alpine arêtes, most notably the upper part of the Furgg Ridge of the Matterhorn, by employing gangs of men, from above and below, to fix pitons, ladders, and ropes. This is steeplejackery, not mountaineering.

The use of an ice-axe has been suggested to form a piton for the last man descending over a *bergschrund*; the axe, of course, in the case supposed is lost. It might pay, should such a forced descent appear at all probable, to carry a two-foot wooden baton as a piton. In a struggle to get down a steep ice-slope before dark, if a couple of such pitons could be securely fixed in the ice they might save a deal of time, labour, and risk. The members of the party could lower themselves, or be lowered, as far as the rope would allow, down the slope without intermediate steps having to be cut.

[1] This is an iron spike, usually with an eye, used for driving into a rock-crack to secure a descent. (See illustration, p. 113.)

Combined Tactics

I have mentioned the case of the friendly helping hand from above. The helping hand can also be applied below.

This can be developed into the supporting back, shoulders, or even head, and is often styled generally "backing up."

It would be better to confine this term to cases in which one uses back and knee, or more usually back and foot, in climbing a narrow rock-cleft.

Here I mean, by combined tactics, all the means by which the leader is physically assisted by those below to overcome a difficulty. The usual way in which this is done is by the leader mounting on the followers' shoulders, the second being secured, or not secured, by number three.

The only places where I consider this method justifiable, are those where an ample and safe standing-place exists at the bottom of the pitch, such as often occurs in narrow gullies. It is otherwise, except for a well-tried party of team-climbers, a decidedly risky business. The followers may have hoisted the leader into what appears to them to be a safe and comfortable position, but which is in fact the reverse.

If the hoist enables the leader to overcome the difficulties, it is amply justified. If it merely enables him to get over a small bit of the "utterly impossible" in order to commence on the "excessively difficult," then I think it is not.

I can personally vouch for the fact that the only occasion, during many years' climbing as leader, on which I got into a position where advance was impossible and retreat dangerous, was when I had accepted assistance from "combined tactics."

In some accounts of British climbs which have been published this method seems to have been rather freely resorted to. It seems probable that, in certain

of these ascents, the "backer up" was really the better climber, and, had he taken the place of the leader, "backing up" would not have been necessary. Nowadays, at any rate, a competent leader does not ask for help at these places.

There is little doubt that "backing up" in this fashion in unsuitable places, and under bad conditions, has been responsible for several unexplained wholesale disasters.

The best-known disaster due to this was the loss of Mr. O. G. Jones, a well-known Lakeland pioneer, along with three guides, on the west ridge of the Dent Blanche in 1899. Mr. Jones was not the leader; he was one of the backers-up.

Mr. Hill, the sole survivor, was saved by his guide hitching the rope in front of him.

Mr. Hill describes how the accident occurred, the leading guide falling back upon the backers-up.

Incompetence for such a climb on the part of the leading guide, was evidently the true cause of the accident. Mr. Hill's remark shows this. He says: "He frequently required help from those below during the whole climb." Bad guiding was also in evidence. Mr. Hill, after the accident, safely evaded the bad place and crossed the mountain alone.

It may be taken as tolerably certain that, if a leader on a climb must often be pushed up in this manner, involving the whole party in his special risks, he is really not justified in his position. The use also of the ice-axe on rocks as an artificial aid involves grave risks. Dr. Zsigmondy, in *The Dangers of the Alps*, relates the almost miraculous escape of his whole party. The followers here pushed the leader up some iced rocks with an axe. He very naturally fell off, and the party was only saved by the leader's rope catching over a projecting rock on the slabs below the pitch.

Angles

In looking at a mountain face, the angle always appears very much steeper than it really is. In the older narratives of Alpine adventure such terms as "perpendicular," or even "overhanging," were freely applied to places of quite moderate angle. The Matterhorn is a notable example of how repellent this deceptive frontal aspect may render a climbing route.

In old descriptions of the Matterhorn, as seen from Zermatt, it was usually called perpendicular, and in certain lights, even to those who know it well, it does really almost appear so.

It was not until Mr. Whymper got a view of the Hörnli Ridge from the side that he realised that its angle was not excessive. He then made a careful observation, and found that the true angle of the route now followed is only 30°. This is one of the steepest climbs in the Alps.

Even the climbs on the much smaller but frightfully steep-looking Dolomite pinnacles, are a very long way off the vertical.

The ascent of the hand-like splintered prongs of the Funffinger, or Cinque Dita, by the "Thumb" is certainly not over 45°.

It is doubtful if any large rock-face exists at an angle so high as 80°. If it does, it is certainly quite impossible of ascent. A rock-climb of any height, to be possible, must not be over 70°. I do not know of any climb, extending to 1,000 feet vertical, which exceeds that angle. This is not only because the climbing would then be impossible, but also that mountain faces at such an angle are very rare. The point about this is that there are very few rock-faces, of any size, in the world, which are not climbable, and usually by many different routes.

Snow and Ice Angles

As regards snow and ice angles, at what angle will snow lie ? and when can we tell by the eye, the clinometer, and the condition, if ascent or descent is safe or possible on snow or ice ?

I was led to go into the question of snow angles in collecting information for a paper written for the *Scottish Mountaineering Club Journal*, on "Scottish Snow."[1] The conclusion then come to was that no snow-slope existed in Scotland at a higher angle than 55°, and that angle was not common.

The question of the actual angles of snow and ice was raised in an article in *La Montagne* for 1901. "L'arête Nord-Ouest de la Grand Casse." The author, M. Mettrier, remarks: "Il n'est pas excessivement rares de voir relatées des inclinaisons de 60° a 65° sur des pentes de neige, mais elles ont presque toujours la charactère d'estimations hasardées."

The writer of the article gives rather an illuminative example of this himself. He *estimates* the angle of the slope above the *bergschrund* on the north face of the Ecrins at 62°. Mr. Whymper gave an *estimate* for this of "50° to 54°." The actual average, as taken by clinometer by Messrs. Ling, Raeburn, and Walker in 1905, was 52°.

Mr. Whymper states, "I do not think that snow will lie in large masses at an angle of over 45°"; and his experience was wide.

In addition to the experience of others, and of myself, on Scottish winter and spring *névé*, I have taken very many measurements of snow and ice slopes on many mountains, over a range of latitude extending from Norway to the south slope of the Caucasus.

I have no hesitation in saying that I do not believe any extensive slope of unbroken snow or ice exists any-

[1] *Scottish Mountaineering Club Journal*, vol. viii, September 1905.

where in Europe (or in Asia or America ?) at a greater angle than 55°.

It is remarkable how very uniform the angle of "very steep" ice or *névé* comes out. Latitude or aspect seems to make little or no difference. Perhaps on the south slope of the Caucasus the ice is a degree or two steeper than the average, but the Caucasus Mountains are steeper than the Alps.

Ice in narrow gullies, or the snow which produces it, where held up by the roughness of the floor or walls, may for short distances reach 90° ; I doubt if any summer ice-gully exists with so high a general angle as 60°. If it does, it is certainly not climbed.

In thus expressing disbelief in the existence of any extensive ice or snow slope at an angle exceeding 55°, I do not mean that steeper ice does not exist, or that steeper angles have not been climbed. There are many hanging glaciers whose terminal ice-cliffs are, or appear to be, more than vertical. These are certainly not climbed. In making a way through ice-falls, short walls of steep *sérac* ice may have to be ascended at an angle so high as 70°. An ice-wall at that angle is excessively difficult, and involves colossal labour in cutting, even with crampons.

Short pitches in narrow gullies and chimneys have been climbed at an angle approaching 90°.

It may be useful to show some figures of angles, taken by the pioneers of the Alps, and also some taken by modern climbers who have attacked extra steep snow and ice slopes.

The pioneers used nearly always to carry clinometers, and though, as Sir Leslie Stephen wrote, "Some astonishing results can be obtained by the judicious use of a clinometer," still, the figures they give are reasonable and to be relied on. Some more modern mountaineers, in spite of their neglect of snow-climbs, and alleged inferiority on ice, have succeeded in discovering and ascending slopes of snow and ice, at angles from ten to nearly twenty degrees higher than any

conquered by the old ice guides, by judiciously leaving the clinometer at home, and trusting to their impressions. The angles these climbers give are, like the real angles, curiously uniform. The usual phrase is "60 to 70." I do not, however, consider it worth while quoting what are, to use M. Mettrier's phrase, "Estimations hasardées."

Locality.	Authority.	Angle.
Mont Blanc Petites Montées	Count Tilly.	est. 65
,, ,,	De Saussure	clin. 39
,, Grandes ,,	Count Tilly.	est. 70
,, Rochers Rouges	,,	,, 90
,, Brenva Route	A. W. Moore	clin. 50
,, Bosses, steepest	J. Vallot	,, 45
Jungfrau, steepest part	Agassiz	,, 45 47
Dent Blanche	T. S. Kennedy	,, 52
Weisshorn, south face	C. E. Mathews	,, 48 49
Monch, from Wengern	H. B. George	,, 42 48
Sesia Joch	,,	nearly 50
Col. Tournanche	J. A. Hudson	54
Col. des Grandes Jorasses	A. Milman	50
Col. delle Locie	J. A. Hudson	50
Mischabel Joch (a few feet)	Coutts Trotter	58
Aiguille D'Argentière	Adams Reilly	53
Moming Pass	A. W. Moore	50
Eiger Joch	Leslie Stephen	51 52
Rothhorn Glacier	Marshall Hall	50
Ortler	Pegger	45
Bec de Lusiney	A. Reilly	50
Matterhorn Cravatte	Giordino	35 40
Ecrins last slope	E. Whymper	est. 50 54
,, ,,	H. Raeburn	clin. 52
Aiguille Blanche de Pétéret	E. S. Compton	est. 55
Monte Rosa, east face	G. Finch	clin. 45 55
,, Nord end	Reichart	55
,, east face	H. Raeburn	Av. clin. 49
Mount Sir Sandford, Selkirks	H. Palmer	,, 48 50
Piz Cengallo (Couloir)	E. L. Strutt	,, 52 57
Gjertvastind, Horunger	R. Bicknell	,, 52
K2 (Chogori) Karakoram	J. Guillarmod	,, 47 53
Disgrazia, north face	H. Raeburn	,, 52

Rejecting Count Tilly's somewhat wild guesses, which are only given to illustrate the wide difference which can exist between an estimate and the real facts, the average of the remainder, taking the highest figure, comes out at about 51°.

In nearly every case these slopes are called " very steep," or the steepest slopes ever encountered by the author giving the record. I have encountered snow-slopes in the Caucasus at an angle of 54°. These were only ventured on under cloudy conditions. In the afternoon, with sun, such an angle is extremely risky; the snow may go at any moment. Even in cold, cloudy weather, the greatest care must be taken; the party should be widely spread, there should be no slack on the rope, and one at least should always be in a position of security, either on rock or ice.

Of the three examples given from my own notes; I have, of course, very many others, the Ecrins is quite short, the east face of Monte Rosa is longer and more formidable, the north face of the Disgrazia is exceedingly severe, costing a party over eight hours for the ascent of between 1,500 and 1,600 feet.

Now, in looking at a snow or ice mountain in the Alps in summer, if we see an unbroken line of white extending to the summit or ridge, we can be tolerably sure that the angle does not exceed 50°, and is probably, if of snow, not over 45°. Above 50° the slope will begin to be broken up by rocks which project through the thinning covering. At " 60 to 70 " it will be mostly bare rock. After bad weather rocks even so steep as 70° may show white. One day's full sun will turn them black again.

If we are thus very much inclined to over-estimate the angle of a snow-slope looked at in face, there is another aspect which is deceptive in the opposite direction.

Suppose we are descending steep rocks at the foot of which a snow or ice slope extends down to the flatter *névés* of a glacier. We may think it will be perfectly easy to jump off the rocks, and run or glissade down the easy-looking slopes. If the rocks are really steep, say approaching 70°, it is safe to assume that the slope is between 45° and 50° at least, which in the

afternoon, if of snow, means possible danger of avalanches ; if of ice, heavy cutting.

Steep Grass, Falling Stones, and Weather

It has been written that " Steep grass, falling stones, and bad weather " are the three Alpine dangers against which it is impossible to provide, and which are " beyond human control." This has been thought somewhat pessimistic by other authors. I certainly consider the whole phrase decidedly unfortunate.

Steep Grass

By far the largest number of " Alpine fatalities " take place on the steep grass slopes near some Alpine Hotel.

This would seem to lend a good deal of force to the statement quoted above, until we begin to examine the reasons for these accidents, and their number.

For their numerical preponderance the reason is the same as that in the old catch, " Why do white sheep eat more than black ? " They are much more numerously frequented than other places in the Alps. For the other, the reason is that nearly all the people to come to grief on these grass slopes are either complete novices to mountains, or are in search of some flower, often both.

The great majority also wear very badly nailed boots. Many venture on such ground in boots devoid of nails. This is indeed horribly dangerous. I have seen the summer tourist, in nailless boots, even on the hill of Arthur's Seat, at Edinburgh, in dire straits, and a safe descent only effected with serious damage to essential holiday garments. The reasonably practised hill-walker, who is inclined to laugh at these unfortunates, let him essay steep, slippery grass slopes, in boots devoid of nails. He will feel as comfortable as he would in ice-steps in a steep Dolomite couloir,

shod in *kletterschuhe*, and roped to a guide who is an utter duffer on ice.

With good sharp nails and foot-width boots, a steep grass slope is of course perfectly easy to the fairly well balanced mountaineer. Its safe ascent, traverse, or descent is the A B C, the groundwork of all mountaineering craft. The way to deal with it, is exactly the same as the fundamental rule on snow or rock, "Stand up straight," unless the angle is 60° or over, when handholds must be taken, or made.

On such a slope an ice-axe is decidedly useful, but for the man of really good balance, a stout ironshod stick is all that is required.

The fact is that accidents to *mountaineers*, very rarely happen on steep grass slopes. The great majority of "Alpine accidents," reported in the press, are not mountaineering accidents at all.

Falling Stones

As regards the danger from naturally falling stones; while, of course, a stone may fall and ricochet at unexpected times and places, falling stones in general obey the same laws which govern the fall of ice and snow. Thus arêtes, and ribs on a face, will be safe from falling stones unless an exceptional ricochet on the latter. Falling stones on a face soon collect into gullies and channels. Their usual routes, and the places where they are liable to fall, are generally well marked and very obvious, and must be avoided.

If, on the descent of a peak, a couloir has to be crossed or descended which is liable to be swept by falling stones, it is better to wait an hour or so till the sun is off the slopes above.

It is surprising to witness, how soon after the shadows have crept across the snows, the salvos of the mountain artillery cease. The long, white, hissing snakes of the sliding snows dwindle and die away. What was extremely dangerous at three p.m. is perfectly safe at

four, when the relaxed fingers of the frost Jotuns again stiffen, and grasp the shadowed faces in their icy grip.

If, from approaching bad weather or other cause, it is necessary to cross a stone-swept couloir, it should be done as speedily as possible, but only one person should be exposed at once, even if this involves rearrangement of the rope. Quickness and expertness, and small number, here reduce the risk enormously. Not only is the risk reduced numerically, but even more in the duration of exposure to it. The middleman of a crossing party of three is here in a very poor position. If stones fall, he can neither dodge them to one side or the other.

If falling stones are observed coming down a couloir on the way up a mountain, then the ascent is, or ought to be, given up, or another route devised.

Every climber of experience knows that the danger from naturally falling stones is much greater in sound and appearance than in reality. Very few accidents indeed ever happen from such a cause.

In my own experience, I have seen thousands of tons of falling rocks, and many a time heard the whirring scream of the rock-fragments flying overhead, but have never known of a case of accident. A much more real and serious danger is that caused by stones dislodged by people or animals on rocks or slopes above a party.

I have known of nasty accidents, and many narrow escapes, from this cause. The narrowest escape from a falling stone ever experienced personally, was from one sent down by a dog from the very steep grass slopes above the "Chapeau" near the "Mauvais Pas" of the Mer de Glace.

If a party on any climb is sending down stones, unless deliberately clearing a new climb, then it is composed of, or contains, novices or incompetents, and should be given a wide berth. It is a sure sign of the novice, or of the clumsy, careless climber, to send down stones. A really good rock craftsman can climb for hours on rotten rocks, and not dislodge a single stone.

The secret of this is care, deliberation—not slowness—and, above all, keeping the pressure of both hands and feet as nearly vertical to the slope as possible.

Weather

While it is quite true, so far, that weather is still "beyond human control" in spite of the fact that rain can sometimes be produced by heavy explosions, a great deal can still be done by some forethought and observation to avoid any probable danger from bad weather.

In these British Islands one is apt to be somewhat insular in judging weather and climate. In fact, a not unmerited reproach is sometimes hurled against us that we have no climate, only mixed samples of weather. We are apt to forget that many other countries have a climate, and weather which can be depended upon, not for days, but for weeks at a stretch.

Mountains, however, have always more uncertain weather than the flat lands in their latitude.

As a rule, in Europe, the farther away from the sea, and the south-west wind, the more steady a climate have her various mountain groups.

The higher ranges will generally catch the bad weather first. If a party is held up by bad weather in the western, or Pennine Alps, they may find perfect conditions prevailing in the Tirol, or the Dolomites.

The finest weather in the Alps comes with a north or north-east wind. The Chamonix guides will speak with affection of "Le bon vent du Nord," but it should be noted that this wind, if strong, is also very cold on the heights, and may make conditions too severe for difficult climbing.

In such weather, with a clear sky, a small cloud may be observed clinging to, and streaming out from, the leeward side of the summit of a great peak, such as the Matterhorn, or Mont Blanc. As the guides then say, "Mont Blanc fume sa pipe."

This is not cloud in reality, but snow-dust, blown from the windward slopes. It means severe cold. This may not greatly matter on a mountain like Mont Blanc, where any amount of gloves, helmets, and extra clothing can be worn, and which there is no reason why a man who had lost both hands should not climb. It may easily make the ascent of at all difficult rock-peaks quite impossible.

Wind is the greatest difficulty British climbers have to contend with. Alike in summer and in winter, it is often very strong and cold. I have seen a twelve-stone man lifted right off his feet by the spring zephyr which so often blows on Scottish peaks.

British climbers who go to the Alps in summer will be agreeably surprised at the, to them, extraordinary absence of wind on the great Alpine peaks. I have certainly not been in the habit of picking my weather in Alpine climbing, but I cannot remember more than three or four occasions when the weather high up, though described by the natives as "bad," was worse than what would be considered as very moderate on British hills.

The Föhn, a damp, warm wind from the south, will, like our own south-west wind, very speedily put snow-slopes in bad order, and generally put things in motion downwards. It acts with much greater effect upon the deeper snow layers than even the fiercest sun, as it carries warm moisture, with its high latent heat, which penetrates the spaces between the snow crystals and thus quickly lowers the angle of adhesion.

Avalanches, even of fairly old snow, may thus be expected when the Föhn prevails. Routes involving any possible danger of avalanches must be then avoided.

Mist used to be greatly dreaded by the older type of Alpine climber. A few seasons of "British hill weather" would have considerably reduced his unfamiliarity. The British climber almost comes to look upon mist as a normal condition, and takes his measures and his bearings accordingly.

Mist has, however, especially when accompanied by wind, a confusing, and, to use an expressive Scotticism, "deaving" [1] effect upon the mind of even the experienced mountaineer.

The effect of the sudden onset of mist and wind upon the heights may be likened to the feeling when entering the streets of a strange city at night from an underground station. The points of the compass may appear to have got twisted round. We settle mentally where we are. Our brain assures us we are in the right direction. On the compass being appealed to, it declares our brain to be quite wrong. Someone is evidently a liar.

It is as well for the novice to firmly make up his mind that, in such a difference of opinion, it is the compass which is right, his brain wrong.

Cases are known, notably in Skye and Norway, of magnetic rocks, but these, like the ice-axe, only act upon the compass if it is held close to them. It is possible also that magnetic storms may cause a temporary aberration, though I do not know of a case; but the rule holds.[2]

I have known of a party of novices accounting for their descent into a wrong valley, though carrying two compasses, by saying that *both* compasses, which agreed, were wrong.

Wind on the hills is a bad guide for direction in mist. Mountains, as the aviator well knows, twist and deflect the wind into innumerable cross currents, eddies, uprushes, and over-falls. One will often meet with a wind-eddy blowing in exactly the opposite direction to the true wind, and with almost, or quite equal, force.

Cols, in every case, are always the windiest places on the ridges, and therefore the worst places for a halt.

[1] "Deaving" does not simply mean deafening: it implies mental confusion, such as that induced by an explosion.

[2] See Dr. E. Corner's experience, however, on the Ey Hills, *Scottish Mountaineering Club Journal*, vol. ix, p. 167.

In a really strong wind, the top of a very steep ridge or peak is often in almost complete calm.

This is caused by the powerful uprush of the current of air striking the very steep slopes below, deflecting the wind-stream which would otherwise have scoured the summit. I have stood on the edge of an Atlantic precipice, quietly reading a map, while a few yards away the wind rushed shrieking upwards with a force so great that it would have been quite impossible to have thrown oneself over.

If the general shape and structure of the locality is known, or well shown on a large-scale map, crags and steep ground may often be fairly well located by shouting and listening for the echoes, or noting the different wind noises.

Ground contours will also assist in keeping a good direction in a mist.

Of the general weather-signs, a red sky at sunset in the Alps, as at home, generally means fine weather next day. A pronounced green colour at dawn is said to indicate severe cold. Certainly on the occasion in my experience when this phenomenon was most marked, on the ascent of Elbruz, the cold was so intense as almost to cause the defeat of the expedition.

Long wisps of mist-cloud, dissolving and reforming, and gradually mounting higher, on the steep sides of deep valleys in the Alps, are usually a sign of good weather.

In sunny weather, the air expanding, the wind blows up the valley. Cooled in the depths of space at night, the air contracts and falls. In the early morning, therefore, the wind blows down.

When the sun gains power and warms the earth the air in contact with it is heated and expands. It rises till it meets the cold stream still pouring down when, momentarily condensed by contact with this, its moisture becomes momentarily visible. These mist-clouds are really innumerable layers of vapour-laden air passing in and out of visibility.

Lightning

Lightning, as an Alpine weather danger, has been treated of sometimes as quite negligible.

If we make up our minds never to climb an Alpine peak unless in absolutely fine and settled weather, then I think the opinion expressed above is likely to be quite correct.

Unfortunately such weather is the exception and not the rule in mountain countries. In some districts, notably in Dauphiné and the Caucasus, the afternoon thunderstorm is of very common occurrence. At the date when the opinion was expressed (1892), certainly few Alpine disasters could be traced directly to lightning: there have been quite a number since, and a comparatively numerous list of minor mishaps. Disasters unexplained, involving the loss of whole parties, may well have been due to lightning.

In August 1909 a party of three first-rate Italian climbers were lost upon the east face of the Nordend of Monte Rosa. No trace of them except an ice-axe and rucksack was ever found.

On the day of the accident Mr. W. N. Ling and I had accompanied a party of ladies up the Rimpfischhorn, Monte Rosa's northern neighbour. We hurried off owing to the onset of bad weather. Before we got down to Zermatt both the Matterhorn and Monte Rosa were centres of terrific lightning displays.

Mr. F. F. Tuckett, in a paper in the *Alpine Journal* (vol. vii, p. 191), "A narrow escape from Lightning on the Roche Melon," has given an interesting account of his party's experience.

Mr. Cecil Slingsby, author of *The Northern Playground*, and a famous Alpine climber, has most vividly described his party's trying time on the Dent Blanche, when some of them were struck, fortunately without very serious result.

A party of four, two climbers with two guides, were

struck and killed on the Wetterhorn in 1902. A porter was killed on Mont Blanc. Other fatalities have occurred.

In my own experience I have received shocks on three occasions. Once while crossing a fairly low col, once while descending the Italian ridge of the Matterhorn in snow and mist, the third time on the top of the Grand Paradis. The last was strong enough to knock me down and momentarily stun me. Fortunately the place was only a slope of soft snow; had it been of rock the result might have been serious, as we were descending, and I might have fallen on my companion, Mr. W. N. Ling, who was below me. Naturally I am at one with the guides on the possible danger from lightning on the heights.

The guides think, that while tops and ridges are very dangerous, there is little or no risk on even slopes or flat glaciers. This is probably correct.

Every hill-climber who is at all observant knows that lightning does very frequently strike the tops of British hills. I have seen the cairn on the top of Sgurr nan Gillean lying scattered in all directions by lightning, and have also seen the fresh scar, where a great piece of rock had been knocked off the spike of living granite forming the extreme summit of another Scottish peak. Lightning is sometimes very erratic. I have seen in a Skye corrie a three-foot-deep hole, just like that caused by the explosion of an aircraft bomb. This had been made by lightning.

I therefore think it advisable, when the ice-axes begin the strange, weird "chanson du piolet," or "buzzing of a large bee," which indicates a strongly electric state of the atmosphere, to get off exposed ridges and summits as quickly as may be convenient, until the "gushes" cease.

It is certainly worth while to undergo some slight risk to view at close range a great electric storm among the mountains. I have seen many. None gave such an absolutely sublime spectacle, as of a world's last

day, as the sunset storm, from about 20,000 to 24,000 feet, over the great mass of Dykhtau-Koshtantau (17,000 feet), in the Caucasus, seen from the ridge leading down from Karagom, July 26, 1914.

Condition of the Rocks and of the Snow

"The rocks that roughly handle us,
The peaks that will not go,
The uniformly scandalous
Condition of the snow."

The climber poet who penned the above was perhaps a trifle pessimistic, as would beseem his confessed weight (sixteen stone).

It must be acknowledged, however, that conditions are too seldom ideal. This is very naturally so, as conditions most suitable, safe, and easy for rocks may make the snow too scarce, or too soft, the ice slopes too smooth, the *bergschrunds* too wide.

If there has been a lot of snow, and it has melted *in situ* and not slid off or evaporated, the resultant water may refreeze as ice on slabs and in crevices.

Certain very steep rock-peaks are very easily locked against climbers from this cause. Amongst these the Meije in Dauphiné, the Grépon, and the two Drus near Chamonix.

Verglas is a word of dread applied by Alpine guides to this condition. The term is somewhat elastic. A thin, transparent coating of ice on steep and difficult rocks of course renders their ascent impossible. A large amount is uncommon in the Alps in summer. A small amount is quite commonly found in the early morning, after a fine day; it may render too early arrival at the difficult part inadvisable. I have known of a party having to wait over an hour at the foot of the Grande Muraille of the Meije till the sun's rays had loosened the ice sufficiently to render the ascent possible.

The ice is really melted by the heated rocks, to a

very small extent only by the direct sun-rays, otherwise ice-glaze in shade and in cracks would never melt.

On British rocks *verglas* is common at certain seasons. The most complete case of this glazing of the rocks I have ever seen, either at home or abroad, was the north-east face of Nevis and Carn Dearg in November. Here every inch of rock on the whole two-mile stretch of cliff, was covered with a thin film of "black" ice; not even a boulder was possible of ascent.

Good condition of the rocks—that is, their freedom from ice and snow—is most important with regard to the time required to climb them. On icy rocks, which are yet possible, the time may be much more than trebled. The labour also necessarily expended over the clearing of handholds and footholds is much greater, more especially for the first man. In such conditions the difference between the climbers with correct and incorrect style becomes very marked. Here is an instance of the enormous difference in time caused by bad and icy conditions. In 1910 an amateur party in the Alps had to pass a certain col. Everything was badly iced up, and the passage cost them much hard work, and two hours of time. In 1911 during the same month, August, the same party had again to make the passage. This time there was not a particle of ice, and they crossed in ten minutes.

On British rocks in summer the cragsman is not likely to be troubled by the formation of ice, unless perhaps very occasionally on the highest north-east faces, such as Nevis. Rain, however, which is frequent and free, has the effect of softening the mineral and vegetable particles so abundantly adherent to British rocks, so scarce on Alpine, and producing the condition of "greasiness." [1] The fingers slip on this, the hold must be much tighter, leather gloves become slimy and useless, the sodden skin is easily cut, and rain, even in August, is also very cold.

The footholds are not so much affected by this

[1] Mica-schist is particularly "greasy" in rain.

condition. If the nails are fairly sharp, and the boots narrow, these are but slightly worse. The man who trusts to his hands is very apt to be let down, both figuratively and actually. The sharp nails of the rock "walker" bite through the grease, and hold firmly on the rock.

In the Alps in summer, after a spell of bad weather which is followed by good, the new snow will begin to slide off, like the snow from a roof in thaw. It will come off quickest where thinnest on rocks, and where thickest on ice. It is recommended to allow steep Alpine peaks four or five days to thus purge themselves. This is certainly ample. If so long had been allowed in the bad Alpine seasons of 1907, 1908, 1909, and 1910, almost no climbing on the great peaks would have been done. A couple of days' full sun should be enough, in July and August in the Alps, to evaporate or slide off the new snow from places where it might constitute a danger, and to incorporate what remains with the old surface.

It is often not fully realised what a very large proportion of the new snow in summer is evaporated direct. Snow, even on the very top of Monte Rosa, may be seen running off as water, but this is only where it is in contact with sun-heated rock. It is doubtful if the snow on the rounded top of Mont Blanc or Elbruz ever melts, it certainly evaporates enormously; but, though the separate crystals must pass through the aqueous form before being vaporised, the snow remains dry all the time.

It is often difficult, in Alpine narratives, to know whether the party was dealing with ice or snow. Though it is usually termed ice, it is often evident that it was in reality nothing but hard snow. This is proved sometimes by the times given as employed in the making of the steps. No guides, except in a kinematograph film, could possibly have made steps in *ice* at the rates mentioned; also from the fact that, if one goes to these places, under similar conditions of

time and weather, one meets with nothing but hard snow.

Snow and ice certainly grade into each other. I think a distinction is best drawn by whether it will splinter or not. If a hard, tough, bone-like substance is met with, which, however, will splinter under blows from the axe, then I think this should be called ice. If the pick merely sinks in and has almost no effect, then it is, however hard, still snow. Perhaps snow-ice, or *névé*, may be used to describe this condition.

I am here, of course, describing the snow structure as it affects the climber. For a reasoned theory of the changes undergone by the snow which is born in a mist-cloud on a mountain-top, till its final death as ice in the glacier tongue, I must refer my readers to the volume on the subject by Professor Heim of Zurich.[1] Dr. Heim's theory is, however, not without difficulty of acceptance in its entirety. For earlier theories the works of Forbes, Agassiz, and Tyndall may be consulted.[2]

Good snow is snow which is firm and reliable, in which rapid and safe progress can be made by kicking steps. Snow rather harder than this, in which steps must be slashed by the adze of the axe, is also to be termed good. On neither of these kinds of snow is any danger of avalanching off to be feared.

A considerable quantity of snow is often an advantage on Alpine climbs, not only may it render the passage of the glacier and *bergschrund* easier, it may also render the ascent of certain couloirs safe and easy, which without it might be difficult, and dangerous from falling stones.

The angles of steep snow have been dealt with elsewhere. In winter the avalanche angles of snow are very much lower. Great danger may be incurred on the lower slopes of Alpine peaks at that season from large avalanches, at quite low angles of inclination.

[1] *Die Gletscher Kunde.*
[2] *Forms of Water.* See also List of Books

Masses of powdery snow, the *Staublauine,* may slide with slight warning. These are particularly liable to be started by the track cut by the ski along an easy slope, and places liable to them must be carefully avoided.

This form of snow is rarely dangerous at high angles, either in winter or in summer, as it does not lie in any quantity on steep slopes, but runs off as it falls, unless bound, as it occasionally is, by an icy crust.

The British winter mountaineer may encounter a stream of this powdery snow on the ascent of a steep gully. This is not often heavy enough to be dangerous, but it is as well not to incur the risk of being snowed under at a narrow place where the stream cannot be avoided. If the condition is not encountered till some considerable part of the gully has been ascended, it is better to go on. Every foot of height gained will, of course, reduce the weight and volume of the stream, and it is much easier to watch for the " freshets " and avoid the current. Hitching should be here as carefully carried out as on the most difficult rock-face, and fortunately hitching, by means of the axe-shaft, is very easy.

If, on the ascent or descent of an Alpine peak, a couloir or slope is encountered on which the snow is rather doubtful, it is much likelier to prove safe, if the correct, that is the bolt-upright attitude, is always adopted. When this is done the compressed snow forms a wedge between the foot and the ice, and the step will hold firm. If an attitude at all leaning forward, or towards the slope, is assumed, then the pressure of the feet will tend to take an outward direction, and the step is liable to be scraped off the ice. A slip, perhaps producing an avalanche, is likely to occur.

If steep snow is really doubtful, the safe method is to remove it, and make steps in the underlying ice or *névé.*

It has been suggested that the safety of a doubtful couloir on the descent may be ascertained by throwing

into it a few large stones. I do not consider this at all reliable. If the stones produce an avalanche, they merely confirm what was practically certain before. If they do not, it does not at all prove that the couloir is safe to descend without precaution. One of these three methods of dealing with the difficulty should be adopted: (*a*) Avoid that route. (*b*) Wait till frost sets in. (*c*) Cut steps through to the under-surface, and always have at least one member anchored to rocks at the side.

As mentioned, powdery snow is only encountered at steep angles when bound on by a crust of ice. This is difficult to deal with. Its occurrence has been referred to in "British Climbing." I have met with it in considerable quantities on the Zinal Arête of the Dent Blanche, on the Moine Ridge of the Aiguille Verte, on the ridge of the Scerscen, leading to Piz Bernina, and elsewhere. It rendered these traverses extremely difficult, and enormously laborious.

On the Dent Blanche, indeed, it almost beat the party, Mr. W. N. Ling and myself, and drove us out on a most disagreable traverse on the iced north face of the final peak. It is fortunately not common on such sharp arêtes as those mentioned, in good seasons.

Frozen Turf

When this is hard, and there is little or no snow, it is a very difficult condition to deal with. For a short distance, the ice-axe is efficient, but the work is very slow and laborious. Though common in Britain in winter, it is not likely to be met with in the summer Alps. Ludwig Purtscheller, the famous Austrian-Tirolese mountaineer, recommended crampons for use on frozen turf. These do well if the crampon spikes are quite sharp. It might, on occasion, pay to carry crampons for dealing with this; but, as a rule, steep faces of mixed rock and turf in this condition should be avoided.

Orientation

Perhaps the most valuable part of mountaineering art is orientation, or pathfinding.

This by no means merely implies the simple and elementary pathfinding involved in finding one's way back by a route followed a few hours before.

This, though the guide's ability to do it used to fill Alpine pioneering amateurs with almost awestruck admiration, is the veriest A B C of orientation. Far from being an "instinct" incapable of acquisition by anyone not born an Alpine peasant, this is simply a matter of some little practice in observation, and can readily be learned by anyone of average intelligence who likes to take the trouble.

The simplest and quickest way to learn the elements of the art is, as the guides unconsciously learned it, by walking, not climbing, on hilly ground, and *avoiding* all difficulties.

It is true the expert in orientation is born, not entirely made; that is, no amount of scientific orientation with map, compass, etc., will enable the student of pathfinding to excel the man who has the faculty; be it the sense of space and distance, the "bump of locality" added to a thorough knowledge of map, compass, and photograph reading. It is also certainly the case, that there are many men, excellent mountaineers in other ways, who always seem to remain in the infants' class in this department.

But if few amateurs can hope to take honours in both natural and scientific orientation, there is all the more reason why they should seek to thoroughly understand the side most guides are deficient in.

There is another form of orientation, in addition to the natural and scientific, much practised in climbing both at home and abroad, but which I consider hardly comes under the definition of mountaineering art. This may be called the artificial or conventional.

Conventional Orientation

The most elementary form of this is the finger-post. We must also include here all artificial marks, or indications of routes to be followed, such as scratches on rocks, footsteps in snow, broken bottles, pieces of paper, cairns, and daubs of red paint.

This red-paint guiding device is almost like an eruptive disease in certain parts of the Eastern Alps. Switzerland and France are yet happily largely free from it. It is even carried up actual climbs in some places. I am convinced that these city-cab-horse-blinker methods of orientation are responsible for many accidents, and not a few deaths. Young, ignorant fellows follow these marks, thinking that of course everything must be all right. The way or the weather gets too hard for their inexperience; they fall and perish.

This was recognised as a danger so long ago as 1885; it afterwards greatly increased; by perhaps the most capable and scientific mountaineer of his age—he died at twenty-four—who ever lived, Dr. Emil Zsigmondy. In his book, *Die Gefahren der Alpen*, he writes: "Auf diese Weise ist der Besuch von diese, schöne Berge fur Leute erleichtert, welche nicht das geringste Stück von Bergkentniss oder Kartenlesen haben, und auch manche Unglücke vorgebeugt." [1]

It has been recommended that, on rock-climbs where difficulty of finding the way back may be feared, cairns should be built and pieces of paper placed at intervals on the way up. In the Eastern Alps packets of papers can even be bought for this purpose.

A cairn here and there, at places where it seems probable error might arise, is perhaps useful and legitimate. A climb is not a paper-chase, however, and a

[1] "In this manner is access to these beautiful peaks made easier for people who have not the slightest knowledge of mountain 'country,' or of map-reading, and thus many accidents are produced."

leader's eyes would be better employed in observing and noting the terrain than in groping in purblind fashion from cairn to cairn, or from paper to paper.

It is certain that this shoddy method of mountaineering is responsible for the deaths of many young continental climbers.

When a party is reduced to the necessity of following this system, it proves, to my thinking, that they are undertaking a climb for which they are really unfit. It *may* come off all right, but the leader has not sufficient ability, or experience, to justify him in leading the party. A cairned route which they are following may also lead into a *cul de sac* or impossible place where the original climbers had turned back; but there is nothing to indicate this, and the leader of the followers has not enough experience to see this.

The fact is that all these conventional orientation methods, such as I have mentioned, and also meticulous handhold labelling, literary climbing guides, are not mountaineering lore at all. They are merely cribs. Used simply as notes, they are often quite useful. The student who confines himself to the study of cribs, will never make a scholar. The climber who relies upon this form of orientation, will never become a mountaineer.

Natural Orientation

Natural orientation is very difficult to explain or teach. If a man has it in him to learn he will pick it up, to some extent, more or less unconsciously.

The faculty should not be described as pathfinding in the sense of being able to follow a known route on a map, or from a description or photograph. Pathmaking is a better description of it. It means the *knowing* the best way in hill-country where none of these things exist. It also covers every detail of mountain craft on rocks or ice, from the smallest rock-climb to the greatest ice-fall.

In effect it is the faculty of choosing the line of least resistance, the easiest route, even on places sometimes invisible.

On a steep little rock-climb the projected judgment of this may be very short. On a great new peak it may be miles away, but in essence the principle is the same.

This often looks like intuition; but, though there is a certain amount of intuition in knowing how to put together and utilise fragments of knowledge, it is yet really a kind of projected experience, as it were, of similar climbs and conditions, encountered and made, it may be, years ago.

It is thus almost impossible for a young man to be a really good guide, unless he is one of the geniuses for whom ordinary rules are not made.

For those who have not got the faculty, or who, though possessing it in some measure, have not the years or experience, the most reliable methods of orientation are the scientific.

It is always as well to supplement these, when possible, by methods drawn from the practical experience of oneself or of others.

Scientific Orientation

How to read the Map and Compass.—For very accurate bearings the prismatic compass is used.

This is a compass to which a prism is attached, through which we can readily read off the bearings on the card. In connection with this an instrument called a protractor is used. The handiest form of this is a semicircular plate of celluloid. In the centre of its straight-edge an arrowhead is marked. The curved edge is divided into degrees.

To find True Bearing from a known point, A, to a known point, B.—Lay the protractor on the map with its longer edge parallel to true north, the inner edge to the left, if B is east of A, right, if west. Place the

arrowhead at A. Now read the bearing where the line A B passes graded edge, and take the figures below 180° if B is east, above 180° if B is west, of A.

To find Magnetic Bearing.—Lay the protractor with the arrowhead at A and its inner edge parallel to magnetic north line. The true bearing is thus 18°.

To find an Unknown Visible Point, B, on the Map.—Take compass-bearing. Lay the protractor parallel to magnetic north, and with the arrowhead at the spot where the bearing is taken, A. The line drawn from A on the correct bearing given by the protractor will pass through B.

To find with the Compass the Time by the Sun.—The sun's true bearing at 6 a.m. is 90°. It moves one degree in four minutes. Suppose the sun's compass-bearing is 120°, then the true bearing is 120°–18° = 102°; 90° = 6 a.m. and the excess of 102° over 90° = 12°; 1° = 4 minutes ∴ 12 × 4 = 48. The time is therefore 6.48 a.m.

. . . . .

In most places and countries magnetic north does not coincide with true north. In the foregoing examples I have taken the amount of this variation, as it is called, for the centre of Great Britain in 1920 as 18° west of true north.

In speaking or writing of directions taken, whether in mapped or unmapped districts, it is always better and clearer to give the true directions, and for this purpose we have to know the variations. Tables of this, for most places in the world, are given in the Nautical Almanac. These are revised every few years, as variation is a fluctuating figure.

There are various theories by which variation is attempted to be explained. None are quite satisfactory. The subject is a very intricate one, and cannot be dealt with here.

All maps are published with the true direction, which does not vary. Most good maps have printed on them an engraving of a compass-needle, showing the

magnetic variation for the date and locality when and where they were published. The actual variation for subsequent dates can be readily ascertained by means of the Tables of Variation given in the Nautical Almanac.

As an instance of the hopeless confusion into which we should fall if we did not always reckon in true direction away from the locality in which we happened to be, I may take Canada.

There Halifax is 22° west, Vancouver is 25 east°, of true, a total divergence of 47°.

Orientation in General

Though a prismatic compass is necessary for very accurate bearings, it is often heavy. A good, not too small, compass, with luminous points and floating card, is quite sufficient for ordinary mountaineering: fairly accurate bearings can be taken with this, and of course the prismatic has no advantage over it for steering in mist or darkness.

There has been brought out recently an excellent marching compass, first-rate also for mountaineering, the lid of which forms a circular protractor. It is also provided with luminous points for night work, is legible, and light. It is called the Magnapole.

The compass is one of the most useful tools of the mountaineer and is a very trustworthy guide for *general* direction on the mountains, more especially in mist or darkness. The route indicated by it, the direct route, is rarely the best, or even a possible route. It is essential to work with it in conjunction with the map, or previous knowledge of the district by a member of the party. The element of time, taken from a last definitely located place, must also be taken into consideration, and this made a rough dead reckoning, according to the nature of the ground traversed, and its angle. The aneroid is a very great help in orientation under these difficult conditions.

[1] See Chapter II, p. 41.

The use of a pedometer has been suggested, but though some hill-walkers seem to have found these of use, I think this can only be the case on very smooth and easy ground.

It is much easier to find the way, apart altogether from climbing difficulties, on Alpine peaks than it is on British hills. An Alpine arête is usually very definite. A glacier, once constituted as such, is as definite as a great river. As in journeying down a river, when we come near rough rapids or falls, we make a portage on the bank, so on the glacier it is usually best to clear off the ice before becoming involved in the *séracs*. We may otherwise, like the first party to descend the Saleinaz Glacier in the Swiss part of the Mont Blanc range, have an exciting time, and spend a cold night out.

Though it is easier to find one's way on Alpine peaks than it is on homeland hills, the consequences of losing it is likely to be more serious on the snows. It is better to learn at home how to find the way.

Water, according to the axiom, always runs downhill. It is therefore, like the compass, an infallible guide to the right direction, supposing we are on a hill, and desire simply to get down. It does not follow, however, that it will always do to closely hug a watercourse. This may drop into a ravine, or plunge over a cataract. Neither of these ways may be convenient. It will, as a rule, be better to keep some distance away from the stream on either hand.

The easiest time and place to lose the way is when leaving a cairn or summit in mist. A very slight divergence here leads to an enormous error in a very short distance.

On arrival at such a point, careful note should be taken of the direction from which the party came, and this should be at once marked by means of an ice-axe, an arrow drawn in the snow, or built with a few stones in the absence of snow.

The larger the party the easier is the losing of the way. A solitary hill-walker *has* to note everything, and this

shortly becomes habitual; he is little likely to go far wrong.

In a large party there are always distractions of various kinds. Unless someone is definitely in charge there are apt to be discussions, perhaps disputes, which consume time, but do not lead to the clearing of either mist or mistification.

One of the most difficult problems in daylight orientation presents itself under the following conditions. These are fairly common on British hills, say the Cairngorms, in March and April. A high plateau, covered with a uniform coating of crusted snow. Mist, and a strong, cold wind, blowing a stream of fine ice-dust across the frozen waste.

The eyes are here at a loss. The angle of ascent or descent can only be judged by the amount of labour necessary to make progress. The sense of isolation is very great, as the visible circle is extremely narrow.

The visible world, being small and restricted, has its visible objects placed, as it were, behind a huge blurred telescope lens. The waving stem of a dead weed is a tree, or a man; a sheep, a woolly mammoth; and a boulder, a beetling cliff.

Constant reference must here be made to the compass, and it is better for both the first and last men to carry and consult one at frequent intervals. It is easier for the last man to detect slight variations from the correct direction, as he has the rest of the party in front of him to check his steering by.

Winter Mountaineering in the Alps

Winter climbing in the Alps is now somewhat overshadowed by the enormous popularity of the allied sport of ski-ing, but at that season very good climbing may frequently be had. As regards the weather, this is often far finer and more settled than in July or August.

The disadvantages are the shorter days, and the

greater cold, as well as, in the case of the rock mountains, a greater amount of ice and snow on the rocks.

It is actually the case that the high peaks may be warmer in winter than some of the deeper and more shadowed valleys. The mountain summit may be bathed in ten or twelve hours' continuous sunlight, while, owing to the sun's low altitude above the horizon, not a ray is able to penetrate into the villages at its foot.

One of the chief difficulties for the winter climber used to be the access to the huts, and the want of guides and hotels at that season; but this has been greatly modified by the development of ski-ing, and other winter sports. In some centres, indeed, the hotels are fuller and the accessible huts as much frequented as they are in summer.

The danger from large avalanches on the lower slopes, which, of course, does not exist in summer, must be reckoned with and avoided. There is an increased possibility of falling into a crevasse, as even large ones may be covered and concealed by a mass of unconsolidated snow; but the climbing on the actual peak may be almost as easy as in August.

Skis may be helpful on quite a large part of the upward way, and a swift and delightful method of descent. In places or under conditions unfavourable for the long snow skate, rackets can be employed. These are string network frames, on the same principle as the snow-shoe of Canada.

The same costume as that worn in summer is quite suitable, but a larger supply of extras, Shetlands, etc., gloves and socks, should be taken.

It is a great advantage to have a good moon at the time of the expedition, but naturally the days are not nearly so short as they are, for instance, in the north of Scotland, in December and January. The chief danger to be guarded against in Alpine mountaineering in winter, is the sudden drop in temperature immediately the sun sets. The best month in winter would seem to be January.

CHAPTER XIV

FOOD, DRINK, HEALTH, AND MEDICAL

THERE is fortunately no occasion in mountaineering—is there in any sport or exercise ?—to follow any food fads, or cranky training rules as regards food and drink. Eat what you like and what suits you, and the same with drink—of course both in moderation. This applies at low levels and off-days at hotels. Exigencies of portability and ease of digestion limit, to a large extent, what is available on the heights. Food difficulties at great heights will be discussed in the chapter on "Exploration." This chapter deals with provisions for heights up to the highest in Europe, Elbruz, 18,500 feet.

Most home climbers, who will be absent from their base for perhaps eight or ten hours, usually content themselves with bread, butter, and jam. Probably a piece of cake, and a few prunes, raisins, or dates will be added. The climber soon finds out that the usual hotel meat sandwich is a dry, unappetising, and difficult proposition to tackle on a long, hard climb. Potted or tinned meat pastes used at one time to be popular. These are indigestible, thirst-producing, and often somewhat mysterious as regards origin. Their food value is low. Cheese, for those who can manage to digest it during a climb, is better than meat pastes. In the Alps, nowadays, the average climb, hut to hut, occupies much the same time as the British climb, and the food can be exactly similar. It is a great mistake, previous to, or during such strenuous exercise as is climbing, to load the stomach with quantities

of rich, indigestible foods. This procedure, combined, as a rule, with heavy overdoses of strongly alcoholic liquids, was very commonly the case among many of the earlier parties attempting the ascent of Mont Blanc. The natural result, a violent rebellion of the abused stomach, was then called " mountain sickness." The great majority of the cases in which this used to occur on European Alps, can be put down to want of training, over-eating, and alcoholic excess. Moderation, training, and common sense have practically banished it from the normal Alpine climbers' ken. Mountain lassitude is, however, real, and not a spirituous bogy like the other ; it is dealt with under " Exploration."

Matthias Zurbriggen, the famous guide, in his book, *From the Alps to the Andes*, says : " For myself, I never eat upon the mountains." This is perhaps going to the other extreme, and is too Spartan for most.

Large tins of soups, with self-cooking arrangements, used at one time to be taken by mountaineers. These can be carried by those who have ample porterage, and who like tinned articles. They are apt to be nauseous to some, and their disproportionate weight for value will banish them from the menu of the guideless mountaineer. Soups in powder form are now to be had. These are portable and nourishing, and, if not very palatable by themselves, can be improved by various simple additions, as meat essences, grated cheese, a pinch of sugar, or a spoonful of cognac. They are labelled with a large variety of names, and, if the consumer uses his imagination properly, he may believe the variety real, and not merely titular. It should be noted that the boiling time given in the directions must be doubled at 10,000 feet.

Bread, as elsewhere, is the mainstay of life upon the mountains, and it is surprising what a large quantity will be found necessary. For a party of three or four, who expect to be away from their hotel for thirty-six hours, eight or ten pounds will not be too much. One

of the chief difficulties in climbing exploration is the impossibility of carrying enough bread. For the purpose of enabling enough bread to be eaten, jam is the mountaineer's great stand-by. Pleasant and easy to get down itself, it aids the consumption of the bread, rather dry and uninteresting otherwise.

Butter is not always to be obtained in the Alps, or in the Caucasus for that matter, and in the former goes rancid with extraordinary rapidity. I remember a very honest old woman, in a Zermatt shop, refusing to sell me butter, because, as she pointed out, it already smelt very bad. A Russian geologist working in the Caucasus, was found to possess butter : it was in tins, and came from Petrograd !

Bacon seems to be less used by mountaineers than it deserves. It is appetizing, easily cooked, and furnishes in a palatable form the necessary fat.

Eggs are the most portable and convenient form of meat foods for the heights : if carefully packed in separate papers, and fitted tightly into a vessel, say a cooker, they will not readily break. If the shells are first washed, fuel can be economised by boiling them in the soup, or in the water for tea. They can also be fried, alone or with bacon. It should be noted that, at 12,000 feet, as for instance the Italian Matterhorn hut, a three-and-a-half-minute egg takes fully five minutes. Hard-boiled eggs are undoubtedly the most portable. Some find them very unattractive, and they are difficult to digest. A little salt and pepper should never be forgotten where eggs are taken, unless for those who have acquired the alleged grandmotherly art of imbibing them raw.

To the huts may be taken cooked or half-cooked meats from the hotel, beefsteak for instance, or a piece of mutton. Chickens, or their legs, can be reheated—by the way, Alpine fowls are credited with possessing six legs apiece—and, if porterage is ample, tinned fruits make a pleasant dessert. Many of the huts are nowadays small hotels, where many kinds of tinned articles

can be bought by those who can eat tinned meats. Tinned meat, as a rule, is better kept as an "iron ration"—and given away at the end of the trip.

The best light accessories on the heights are sweet rusks, called in Norse "Kavringer," in German "Zwieback." Sweet biscuits are also good. These share with the rusks the disadvantage of fragility. Various sweets are also useful, and some like chocolate. Others find that thirst-producing and drying to the mouth. Dried fruits are most excellent, and of these prunes are probably the best. It will be found that something of a sugary nature is easiest got down, and also throws the least strain upon the digestion. Sugar is, however, like its derivative alcohol, only for short-period effort. We cannot continue to do strenuous work on sugar alone. Therefore it is important that our Alpine holiday off-days should be ample, and that we should have plenty of nitrogenous, nourishing food on these days, otherwise we may lose too heavily in weight.

Drink

By far the best drink for mountaineers is mountain water. Few, except those who have known what it is to be really thirsty, in the thin, sun-smitten air of the heights, where the bodily evaporation is far greater than at sea-level, know how delicious water can be. All water above house-level is sure to be pure and good. Below villages, or inhabited chalets, it is best to be careful in the choice of a drinking-place. Water running on a glacier is usually first-rate. So is melted snow-water. Water from the glacier streams is best allowed a few minutes for settling. This water, or generally "glacier water," has been blamed for several Alpine ills: such as the results of eating putrid meat or fish at the hotels. It is safer to avoid *sea*-fish altogether at Alpine resorts in summer.

For a time some medical theorists used to ascribe

goitre, prevalent in certain Alpine valleys, to this water. Other and later theorists declare it has nothing to do with it. In any case, the amount taken on an Alpine holiday will not do any harm. At one time a deal of discomfort and unnecessary suffering used to be endured by climbers, who were told that on no account should water be taken when they were heated, and that the less water drunk during a climb the better. My advice certainly is, drink just as often as you like. Cold water taken during active exercise never does any harm. Of course, if while heated one were to imbibe a quart of ice water, and then sit down in a cold breeze for half an hour or so, a chill would probably result, due all the same more to the wind than to the water. One great advantage of depending upon water in the Alps, and elsewhere, is that it is almost everywhere available, and therefore does not require to be carried on great heights—that is, of course, if the sun is shining. I have made tea with water which was running from melting snow on the very summits of the Schreckhorn, the Rimpfischhorn, and of Monte Rosa (15,217 feet).

I have not the slightest doubt but that water will be found to be running on or near rocks on the Himalayas, at 25,000 feet or higher. Even if water is not always available, there is always snow. I have eaten many pounds of snow, on peaks old and new, and never suffered in the smallest degree from any of the dire ills which are said to result from this. Of course, only a very small quantity of snow must be taken at a time, especially if the temperature is below freezing. Several of the scientific pioneers are strong on the benefit of eating snow. Thus Professor Forbes, in his account of the ascent of the Jungfrau in 1843, says: "None of us suffered from thirst, though we were without water for more than twelve hours. We ate snow, however, pretty freely." The physiologist, Professor Mosso, in 1886, when ascending Monte Rosa, discovered, somewhat to his surprise apparently that snow was

pleasant, thirst-quenching, and did him no harm whatever.

In thus singing the praises of water, I am not in the least influenced by any teetotal fads. Temperance is a well-known virtue. Total abstinence from alcoholic liquids, which may or may not be a virtue, has no right whatever to fraudulently claim the title of a virtue to which it has no relation.

Every form of stimulant indulged in by every tribe and race of mankind is probably, on the whole, of some benefit: regard being paid to time, place, or climate, and moderation.

It seems curious, however, that some people who, for instance, prefer a dilute solution of the virulent narcotic poison, theine, should assume an absurd attitude of virtue towards others who may prefer a small quantity of the much less poisonous alcohol in their beverages.

The effect of stimulants in climbing was most carefully investigated and reported on by a committee of the Italian Touring Club, under the direction of Professor Galeotti, in 1914, the subjects being young Italians and Americans.

Stimulants may be taken as the following most usual: tea, coffee, cocoa, coca, kola, maté, alcohol, oxygen, meat essences.

(1) No stimulants are necessary for Alpine climbing. Plain digestible food, sparingly partaken of, and water, are sufficient.

(2) The effects, say, of alcohol upon the system vary so greatly in different individuals, and even in the case of the same person, at different times, that it is impossible to lay down any law with regard to this.

(3) Small doses of cognac have a beneficial effect on some.

(4) Alcoholic stimulants (and all stimulants) in large quantities are always harmful.

(5) The effect of alcohol at high elevations is ex-

ceedingly transient; the after-depression is greater than at low.

There is no doubt that in former days far too much wine and brandy was habitually carried. Brandy, as will be seen, is not necessary for an Alpine climb. A small quantity, however, should always be carried by one member of a climbing party. It may prove of great value when a short effort is required, say to reach a place of safety. Also after a long, cold wait, or night out, to enable a start to be made. Without it it may be very difficult to get going. Before, or during the halt, it should not be taken—that way lies frost-bite. Natural wines, and beer do not contain enough spirit to make either worth while carrying as a stimulant. Their weight, and that of the bottles containing them, renders them impossible for the guideless climber. Some people nowadays take thermos flasks containing hot drinks, such as tea, coffee, or soup, and, if there is ample porterage, there is no reason why these, or wine, should not be carried. The intolerable weight for value of all liquids whatever will soon banish them from the back of the high-climbing, guideless mountaineer. The most convenient stimulant for the heights is tea. This, of course, necessitates the carrying of an aluminium cooker, and of a flask of methylated spirit; but the first can be got in very light form, and can also be used for soups or eggs, and for the frying of bacon or of beans.

Condensed milk can be got in small tins, and, whether with sugar, or without, is good food value for weight. Milk can now be had in the form of a dry powder. The flavour is rather against it, and, like that of the condensed, is disliked by some, but one soon gets used to it. If condensed milk, and also jams, could be got in collapsible tubes, such as toilet preparations are put up in; this would be the most convenient way in which to carry these. Jams can be got in London in small ¼-lb. tins. These are very handy; as the tops are so thin that they may be cut with an ordinary penknife.

Health and Medical

A high medical authority on the subject of health writes : " Of all the means in the hands of the physician for restoring tone to the jaded system, for purifying the blood, and for cheering the mind, an Alpine holiday is the best." [1]

With all due respect and acknowledgement of the services to mankind of medical men in general, I would prefer to claim for mountaineering, sensibly conducted, that there is no sport or pursuit we can follow which is so likely to keep us out of the hands of the physician. To have the best medical advice in need is a good thing. Not to have the need of it is very much better. There is nothing more calculated to promote, and to keep us in, the fittest possible bodily and mental condition than exercise in the keen, pure air of the mountains.

There are some people who suffer from what used to be called the " vapours." These are by no means always of the female sex. They imagine themselves to suffer from all kinds of physical and mental disabilities. The beneficent fairies of the heights will be found to be most potent conquerors and banishers of such low spirits. Some, however—and this particularly applies to the young and physically powerful—are apt to under-estimate the strain of climbing at great heights. It undoubtedly throws a heavy labour on the heart. Those who suffer from serious organic heart deficiencies should not go in for climbing. A slight heart weakness or irregularity is no bar. This may be purely nervous, and reasonable exercise of any weak organ will strengthen, not injure it.

The best and most easily obtained training for the mountaineer is walking, preferably cross country and hill walking. Unfortunately this has the drawback of requiring more time than can generally be afforded.

[1] Sir Thomas Clifford Allbutt.

A medical mountaineer, Dr. R. P. Cockburn, published an article in the *Alpine Journal* (vol. xxv, 1912), on the subject of "Indoor Training for Mountaineers." Some of his suggestions are ingenious and useful. One of the great faults of all these systems of training, however, is their having to be done indoors; but the real defect is their mechanical and uniform character. Once the trick of a system is learned, it becomes mere labour and ceases to interest the mind. Indeed, the over-development of certain groups of muscles, such as was produced by a quack system of training very popular for a time, creates worse evils than those it was supposed to cure.

Dr. Cockburn warns against this foolish fad. He states very truly it renders the muscles "slow in action, prone to stiffness, and tend to undergo fatty degeneration."

The great benefit and beauty of mountaineering from a muscular development point of view is that, unlike so many sports and pastimes, its variety is infinite, and every muscle is exercised on both sides of the body equally. Sculling is a good mountaineering training, right-handed weight-lifting perhaps the worst.

No attempt will be made in this volume to give general medical or surgical advice. Everything in the least likely to be wanted, or useful to the amateur, can be found in any of the small text-books on "First Aid."

An able literary man can write a volume on a *Tour Round My Garden*.[1] A learned surgeon could write a library on what *might* happen on a climbing expedition —or, for that matter, on crossing a London street.

A small volume was published in 1907 [2] which deals very fully with possible mountaineering accidents. It even discusses the best way to deal with the epileptic, or suicidal or homicidal maniac, on a difficult climb. It quaintly suggests that "It would be dangerous to

[1] Alphonse Karr.

[2] *The Climber's Pocket-book*, by L. T. West.

attempt to quieten the patient (or impatient ?) by blows on the head," and advises gentler, kinder methods, such as throttling. One might suggest that if the patient's conduct became habitual, it would be really kinder to him, and certainly much kinder to his friends, to knock him quietly on the head, and deposit him in the nearest convenient crevasse. Seriously, of course, anyone who suffers from epilepsy, or sudden attacks of acute mania, and attaches himself to a roped party, is a dangerous criminal, and ought to be treated as such.

Blisters

These are much commoner than mania or melancholia. The way to avoid getting them has been dealt with under "Boots and Stockings." Wear double foot-coverings. If this has not been done, and the skin gets rubbed and dirt enters, a very painful sore may be produced, leading perhaps to the total loss of the climbing holiday. As soon as possible after the rub has taken place the foot should be most carefully washed with some dilute disinfectant. The best protection is liquid collodion, or " Newskin."

With a clean strip of linen bound round to take the rub, and as much rest as possible, healing should, normally, take place in a few days.

Snow-blindness

Prevention is very easy ; always wear goggles when on a snow-field, and remember carefully that, as with sunburn, mist does not stop the chemical rays which do the mischief.

If from any cause the precaution has not been taken, snow-blindness, either slight or severe, may come on. It is an exceedingly painful affection, and the sufferer may have to be confined to a darkened room for several days. It does not appear to result in permanent loss of sight. A few drops of a dilute solution of cocaine

may be used to ease the pain when severe. Rest and darkness is the cure.

Sunburn

Prevention is again very easy. Give a good well-spread coating of "Pomade Séchéhaye" before entering upon an Alpine snow-field. If the unprotected skin of the average person is exposed for quite a short time to direct sunlight at high levels, not merely on glaciers or snow, it will suffer very serious damage. It should also be very carefully noted that the skin of the fore-arms, feet, and legs is even more easily affected than is the skin of the face. In bad cases great blisters form full of liquid. These break, and the greater part of the outer skin may be lost. The pain and irritation may be quite sufficient to prevent sleep for a night or two. Healing is long and tedious, and the new skin at first extremely tender. There is no cure but time. Some emollient like zinc ointment, is said to ease the pain and discomfort. It is much wiser to always plaster than to risk "glacier face." Ordinary exposure, and the tanning of the skin resulting, gives some measure of protection. Fair people suffer more readily than those with dark, sallow, or muddy complexions.

Frost-bite

There are three degrees of frost-bite known to surgeons. Perhaps we might add a fourth, from the experience in the trenches during the Great War. This was cold-bite, due to standing for many hours in cold water. In extreme cases the results of this were as serious as the third degree of frost-bite, the death of the tissues and the necessity of amputation in order to save the victim's life.

The first degree of frost-bite is fairly common, and is not serious. The symptoms are a loss of sensation in the part affected, and a tallowy feel and colour. Drying, gentle rubbing, and protection from further cold

will cure it in a short time. The part then becomes exceedingly painful from the returning blood. No permanent results are felt.

The second degree is worse, and the ultimate effect is not unlike that caused by sunburn. Blisters form, and the outer skin eventually peels off. The nails may also be lost, and sores may form owing to the death of the under-skin.

In the third degree, the frost has penetrated so deeply as to kill the cells of the parts affected, even to the bones. These parts become gangrened and eventually drop off, or have to be amputated to prevent blood poisoning.

This degree of frost-bite is rare in Alpine climbing. In cases where it has occurred it has usually happened to a badly clothed, fed, and shod second guide or porter, who has spent a night high up in bad weather, has neglected the warning of loss of sensation, and has also had, perhaps, too free resort to the brandy-flask. With a well-fed, well-clad party of mountaineers on the ordinary Alpine climbs in good summer condition, even the first degree of frost-bite will very seldom occur.

Frost-bite comes on much more readily if the part has been wet. This emphasises the great importance of having a change of dry wool gloves on a snow-climb. Wind is perhaps the most important factor in producing frost-bite; therefore the first care of a storm-stayed party, or one faced with a night out, must be to get out of the wind at all costs. Cols are always the windiest places on mountains.

A very useful article, "On the Health and Training of Mountaineers," was published in the *Alpine Journal* as long ago as 1876. This was by Sir T. C. Allbutt. It is full of the soundest practical advice, and deserves to be read by all climbers. As regards diet, he writes: "A time of stress is not the time to annoy the stomach with strange foods. . . . On climbing days the food should be small in bulk and easy of digestion. . . . Cold tea is not very nice, to my thinking, and, when fine

mountain water is to be had, what more does a man want ? . . . Men who are small eaters, and have but weak digestive powers, are often the better of a little weak alcohol with their food. . . . After hard work, let the evening meal be simple."

1

2

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All Harold Raeburn.

1. CORNICES ON NUAMKUAM.

2. BERGSCHRUND OF SARAMAG.
Looking for a bridge.

3. ICE-TUNNEL IN NUAMKUAM GLACIER.

4. LOWEST ICE-FALL OF THE TSAYA GLACIER.
With huge *Séracs* in distance.

CHAPTER XV

EXPLORATION

Exploration, in the geographical sense, is no longer possible in the Alps. New climbs, and variations of old, are yet to be discovered in abundance by those enterprising enough to seek them.

Exploration, in its widest meaning, may also be considered as ended, or fast coming to an end, in nearly all the great mountain-ranges of the world outside the Himalayan or Central Asian area. There are, however, very many world-peaks. Everest, or Chomo-kangkar (29,002 feet), is the most outstanding, which, though observed and triangulated many years ago, have hitherto never been conquered, or even approached or surveyed.

The exploration of mountains is such a vast and important development of mountaineering art, that it would require a whole volume to deal with this part of the subject properly. All that will be attempted here is to give some hints, and a sketch of the methods, equipment, and procedure best calculated to lead to success in attacking the great unclimbed mountains of the world.

Every rock-climber on hills below snow-level, who first makes a way up a face hitherto ignored, or defiant of conquest, is in a sense an explorer. He has in him the germ, latent perhaps, and never to be developed, of the conqueror of the greatest peaks of the globe. It is, nevertheless, the fact, that the key to the conquest of the great peaks is the knowledge of snow and ice. Many modern rock-climbers, and even some of Alpine experience, have wondered at the extraordinary rock-climbing deficiencies of many of the old pioneering

guides. These guides would often persistently stick to a snow route when others, not only easier, but safer, existed by the rocks. The reason of this was, that when the conquest of the Alps was seriously begun, the peaks aimed at were, naturally, the highest in their respective groups. These highest peaks are almost invariably snow-peaks. The Matterhorn is one of the few exceptions to this rule. Even the great rock-peaks of Ushba, in the Caucasus, and the Dent Blanche, in Switzerland, are, under certain conditions, possible of ascent almost entirely on snow. A snow-route is nearly always quicker and easier, though not necessarily safer, than a rock-route. The snow-craftsman, therefore, would have by far the better chance of success ; the rock-climber, however expert, would be apt to be at sea on the snows.

Rock-craft, and that of a high order, may, however, be required in places on these great peaks. The real master of mountaineering arts is the man who has passed in both departments. Such a man is the only ideal mountain explorer.

A good working knowledge of geology is an essential part of the equipment of the exploring mountaineer. He will thus be able to tell, from a telephotograph, or a view through a glass at many miles' distance, the probable nature of the climbing on the peak he is aiming at. He should be able to infer, with a very considerable degree of probability, the manner in which the invisible side of the mountain is built up. For this instinct or intuition he must not only be a theoretical geologist, but have had wide practice in actual climbing on many different kinds of rock and snow mountains. Knowledge of relative distances and proportions can only be acquired by this wide experience. Alpine guides are peculiarly weak on this point.

Emil Rey of Courmayeur, a very fine mountaineer, was invited by Mr. C. D. Cunningham to Scotland in 1884. They ascended Nevis in February. Of this peak Rey remarked, " Mais monsieur, c'est une

véritable montagne là." While in Edinburgh, looking up one afternoon at Arthur's Seat, "that perfect little mountain in miniature," Cunningham asked Emil how long they should take to make the ascent. Emil replied "About two and a half hours." They gained the top in twenty-five minutes. Again, Mr. C. T. Dent brought Melchior Anderegg, "a Swiss guide of almost matchless experience and of great intelligence," to Wales. Standing on the commencement of the Crib Goch ridge of Snowdon, one bright winter's day, Dent asked Melchior how long it would take to reach the summit. Melchior thought it would "take some three hours." Dent estimated they would get up in one, which proved almost exactly correct.

These are examples of over-estimates. Alpine guides taken to the greater ranges, such as the Caucasus, or Himalayas, have often made as wide errors, but this time in a much more dangerous direction. Zurfluh, Mr. Mummery's guide in the Caucasus, was anxious to make the ascent of Dykh-Tau (17,054 feet) as "a training walk." Again, Alexander Burgener, the famous Swiss guide, with another guide, Ruppen, accompanied M. Maurice De Déchy to the Adai group in the Caucasus in 1884. He very clearly under-estimated the difficulty and distance of the peak he was asked to attack, the supposed Adai Khokh (15,244 feet). This was really another mountain about 1,000 feet lower. In the result, though successful, two nights had to be spent at high bivouacs, and the party were very nearly lost. It seems very probable that the young and inexperienced climber, Mr. W. Graham, was deceived by similar failures to understand the relative proportions of the Alps and Himalayas by his guides Boss and Kauffman. His narrative, in my opinion, cannot be reconciled with the actual ascent of the main peak of Kabru.[1]

[1] Imboden was probably the original befogger. Graham and he visited the region in *March*. It seems certain they mistook Kabru for Kangchenjunga.

Photography, especially telephotography, has placed an enormously powerful weapon in the hands of the exploring mountaineer. It is often not sufficiently appreciated, what a large part the photographs brought back by the pioneers have played in the eventual conquest of peaks. In the Caucasus, De Déchy, Dent, Donkin, Ronchetti, Sella, Woolley, Young, are some of these photographers. In the Himalayas, Sella again, Collie, Conway, Kellas, Longstaff, Mumm, De Philippi, and many others. In the Rockies, Dr. Collie again, and a whole host of Canadian and American photographing pioneers.

If the country is imperfectly or badly mapped, by the photographs we can fill the map's deficiencies, or correct its errors. If the photographs are numerous they can serve, at a pinch, should the country be as yet entirely unmapped.

Photographs, even long-distance ones, are thus of great importance as a means to the conquest of new peaks. They may save a long journey, weeks of time, and perhaps bitter disappointment, by showing that a certain side or aspect of our peak is probably too difficult or too dangerous to attack.

Reconnoitring

This is taken as meaning, observing the mountain from a distance, by the eye, or through a glass. It is a method which has been highly recommended, but has its traps for the inexperienced. It is always useful to obtain a general knowledge of the shape and structure of our mountain or group. This is best done by ascending at least two commanding heights, of easy access, in its immediate neighbourhood. Reconnoitring, on off-days, from low levels, is, especially with the glass, apt to be useless, or worse, deceptive.

I have used all kinds of glasses, monocular and binocular, for many years, in bird-watching. For this they are essential. I used also to try them for climbing

study, but have come to the conclusion that, for giving any reliable information as to the possibility or otherwise of a route up a peak, the glass, whether monocular or binocular, is not worth its weight. The telescope is especially deceptive. It may be taken as an axiom in mountain craft, that the greater the rock-face, or mountain, the greater the certainty that a way up it exists. I certainly agree with the saying of the famous mountaineering guide, Matthias Zurbriggen, "Every mountain has a good way." This good way cannot be discovered by means of a glass. The route must be judged from the general comprehensive survey obtained by the eye, collated with former experiences gained in climbing on similar geological formations. A smooth rock-wall only twenty feet high, will effectually stop any party of climbers. The telescope, or binoculars, will, from a distance, merge and confound planes of relative space and size. If near enough for detail to be visible, the information conveyed to the brain will be in small detached sections, practically impossible to fit together.

If glasses are employed at all, by far the best is the prismatic binocular. This should be calibrated, or fitted with a measuring standard, inscribed on a glass disc inserted in the right barrel (see illustration, p. 39). If one of the factors of size or distance is known, we can then calculate the other with fair accuracy.

Even if the mountain explorer is not a deeply scientific man, or is lacking in wide practical experience, he should yet be easily able to do better than the average guide, in a new country, until the latter learns the ropes. If he has maps, and these are merely imperfect and elliptic, and not utterly erroneous; if he knows the average summer snow-level; if he uses an aneroid, prismatic compass, and clinometer; then he can get good data to go upon in judging possibilities, and probable time required.

No attempt will be made, in this sketch, to go into the subject of surveying new mountain countries.

This is really a different subject, and is not necessarily mountaineering at all.

It is, however, highly desirable that scientific government surveyors should be instructed in, and possess at least an elementary knowledge of, mountaineering. Lack of this led to some enormous errors in the earlier Caucasian maps, and lack of it also led to some rather strange statements in many of the earlier reports of Indian mountain surveys.

It is certainly desirable that a mountaineering party in new country should have attached to it a member who is able either to triangulate, or at least to take rough surveys by means of a plane-table, or, better, photometric camera ; but the mountain leader of such an expedition has no time for what, after all, is mechanical detail work. Good weather is none too common on the mountains. The surveyor is best left to do his work at the lower levels when this is the case. He is not one of the climbing party proper. A light camera must take his place on the heights.

Special Equipment

This must be devised with special regard to warmth and lightness. The usual Arctic, I do not consider at all suitable for ultra-high mountaineering. Temperatures even approaching those prevailing for months on end in the Arctic and Antarctic regions, will very rarely be met with, even on the highest of the Himalayas. Low temperatures, in fact, will only usually be encountered at night. Great heat will be one of the most trying conditions in the day-time.

The enormous range of the temperature is the condition most to be guarded against. I consider that ordinary walking clothes, or the usual Alpine outfit, will be perfectly suitable. The clothing may be made even somewhat lighter than generally worn by Alpine climbers, but should be of close, smooth-texture cloth. More extra garments will be needed. Nothing is better

than Shetland wool for these. A suit of very thin, but wind-resisting overalls, should also be taken for use over the Shetlands at night, or before dawn. Just before dawn is always the most trying time on the heights.

Some Factors modifying Temperatures on Great Mountains

Some theorists, in arguing the con side as regards climbs to great altitudes, have laid great emphasis upon the extremely low temperatures likely to be met with. They refer to the tables which have been constructed giving the fall of temperatures as one ascends above sea-level. According to this, the height between 28,000 and 30,000 feet should give a reduction of temperature of about 80° F.[1] These calculations and tables are, however, of little more than academic interest to mountaineers.

Even at 29,000 feet a climber is not off the surface of the earth at all. The direction and force of the wind currents, and the time of day, have much greater influence upon the temperature than the elevation. Every climber to great heights knows that the sun-heat there is very much greater than on the plains below. Here are a few actual temperatures which will illustrate this.

Locality.	Altitude.	Date.	Temp.	Observer.
Shigar . .	7,516	June 1899	206	Workmans
Chogo Lungma .	17,322	July ,,	204·5	,,
Calcot Lungma .	14,067	August ,,	196	,,
Calcutta . .		max for year	162	
Lahore . .		max. for year	172	
Suru . . .	10,850	August 1906	219	,,
Nun Kun Glaciers	15,100	,, ,,	183	,,
Bride Peak XV .	21,673	July, 1909	123·8	Duc D'Abruzzi
Bride Peak XV .	22,483	July 17, 1909	152·6	,,

I have no doubt that, were one on the top of Everest in calm, sunny weather, and were to place a lump of snow on a piece of black paper, it would melt and

[1] Deschanel, *Physics*, vol. ii.

disappear in a very few minutes. The air temperature at night, however, would probably be even lower than what theory demands.

Great mountains act as directors of air-currents. During the day, in fine weather, a constant stream of heated air is rushing up them. This is what accounts for the presence of feeble-flying insects above the summits of even the highest peaks yet reached by man.

Even scientific observers such as Professor Mosso sometimes miss the significance of this. Professor Mosso relates how he watched a flock of choughs (*Pyrrocorax Alpinus*) coming up from the valley below to the Regina hut, to eat the scraps. He was surprised, he says, on observing them closely through the glass, that the birds exhibited no signs of fatigue, or of being out of breath, although they must have climbed 10,000 feet in a few minutes. In reality, of course, the choughs floated up without any exertion to speak of at all, much less than if flying 5,000 feet along the level in a calm. All they had to do was to hold their wings at the proper angle ; the wind did the rest.

This up-rush of air is as regular as clockwork, in fine weather, all along the Italian foot of the Alps, and is the meaning of the almost constant presence of mist-clouds over the high Italian valleys at an early hour in the forenoon. The same thing also occurs in the Caucasus, and probably also in the Himalayas. After sunset the position is reversed. The heated air, cooled in the depths of space, contracts and falls. A down-rush of cold air pours down the mountains. The cold increases till the tide again turns, after the first rays of the sun appear above the horizon.

Another factor which makes an enormous difference in temperatures on high mountains is this. If a mountain is steep enough—say the angle of large portions is between 60 and 70 degrees—to possess large exposures of rocks, it will be much warmer, for many hours after sunset, than a purely snow peak. The amount of solar heat absorbed by rocks at high elevations is very great.

Radiation, in clear weather, is also rapid, but it is a fact that rocks at 10,000 feet in the Alps and 12,000 feet in the Caucasus, can be, after the sun has been for some time set, at a temperature of 60°, while the air a foot or so away from them is under freezing. I have seen, at 15,217 feet, the top of Monte Rosa, within a space of three feet, streams of water running from melting snow, on a partially exposed rock, while a wet glove laid on snow in the shade was frozen stiff as a board in a few minutes.

Equipment

As in all climbing, the boots are the most important part of the equipment. It would seem that the ordinary nailed boot used in the Alps, too readily conducts the cold of the ice to the feet, or too readily allows the natural warmth of the feet to escape.

Ordinary crampons and puttees are too restrictive to the height-enfeebled circulation to permit either to be used. As difficult rock-climbing is not likely to be undertaken, the following arrangement might prove suitable. The boots would be soled, exactly the width of the feet, with two thicknesses of good leather, having between them a layer of thin, three-ply wood, or a sheet of rubber. No nails would be permanently fixed, but a number of socketed small steel plates would be screwed to the outer sole.

Into these sockets could be screwed, or removed at will by means of a box key, either the usual four-pointed ice-screws, or crampons spikes of tough, mild steel. A dozen of these arranged round the edges of the sole and heel, and a dozen ice-screws in the centre, would probably be sufficient; perhaps even fewer might do. The uppers would be carried up the leg to just below the calf, and would be, high up at any rate, of very thin, carefully prepared flexible leather, such as is used for the best Russian boots.

The under-garments, two thin suits, would be in

combination form. No garters, or knicker straps, would be worn. The stockings would be hung by suspenders. The knickers would have a band of easy elastic round the foot, and would be voluminous enough to allow of being drawn down in deep snow, low enough to cover the tops of the boots, to which they would be secured. The glove supply should be most ample : at least two pairs of wool, and two of leather, ought to be carried, and, of course, two Shetland helmets, to keep the head warm at night.

No liquids whatever would be carried, except methylated spirit or paraffin, and a small flask of cognac. Success in the highest climbs is, in my opinion, likeliest to go to the party lightest loaded, and to those best prepared, naturally or by training, to tighten their belts, and yet do as much, or more work, than when on full rations. The fight will be already lost if weeks of starvation, on tinned foods, had first to be spent at low levels.

Assistance and Porterage

The matter of porterage is vitally important in high climbing. Many narratives are full of the manifold troubles due to the weaknesses of the native porters employed. For this reason some have advocated the employment of large numbers of European guides and porters. This, however, besides the very heavy expense involved, is not without its own special drawbacks.

The two climbing expeditions in the Himalayas most completely successful in their aims, were those of Messrs. Rubenson and Monraad Aas, and of Dr. Kellas, both in Sikkim. In both of these the mountaineers relied upon native aid.

These climbers, it will be noted, made their ascents in Sikkim, where they were fortunately able to obtain, select, and train, men of a hardy, powerful, and adaptable race of mountain people, who are free from the clogs, worries, and prejudices of caste.

Those unwilling to undergo the extra labour and trouble of training native lieutenants and assistants, must have recourse to the trained skill and mountain knowledge of one or two European guides. The best of these, for distant and high work, would seem to be the Piedmontese Italians : men born on the southern slopes of the great central Alpine peaks, Mont Blanc, the Matterhorn or Cervin, and Monte Rosa. Nearly all the highest climbing records all over the world are now held by these guides. This may be, no doubt, largely due to the patriotic labours and enterprise of the Duc D'Abruzzi, who has invariably employed Italian guides in all his great climbs.

The Aeroplane

It would appear that in the aeroplane we have the best and most convenient means for a general topographic survey, by photograph, of mountain and desert countries. As yet, however, at very great heights the risks from the great irregularities of wind direction, owing to the cross-currents set up by mountain ridges, are very considerable. Difficulties of landing in unknown mountain country are also very serious. In addition, though it is true that records have been set up (three over 30,000 feet in 1919), considerably over the highest point of earth's surface, yet these records are by no means scientifically accurate. Aneroid barometers, near the extremity of their range, are notoriously unreliable, and at great heights may easily be out by several thousand feet. In any case, it would require every favourable condition, and a heavily stripped aeroplane, even to reach from a well-situated aerodrome, such heights as the highest of the Himalayan peaks.

To pass safely over the Alps requires a plane with a clear " ceiling " of nearly 20,000 feet. The Gaurisankar range would require one of at least 34,000 feet ceiling, with petrol stores, and a convenient safe

landing-ground within 80 or 100 miles of the ridge. This is not yet.

Some have considered that the would-be conquerors of the great Himalayan peaks, might fly up to the top or these, and then land on them.

Landing on a great snow mountain, in aeroplanes furnished with skis, or skids, as were the original machines of the Wright brothers, Farman, etc., is, I have been convinced for many years, perfectly possible. On Mont Blanc, for instance, this should not be seriously difficult. On Elbruz, the eastern peak at any rate, it would not be feasible. At present, landing would have to take place about 2,000 feet below the top.

On the greatest Himalayas, so far as is yet known, the highest tops appear to be formed of sharp ice and rock-ridges; on these, landing would be extremely risky, if possible at all. The ascent of such peaks by means of the aeroplane requires one of a type, such as expanding, or movable wings, not yet proved practicable. There is, however, one very obvious way in which the areoplane could be of enormous service to the exploring mountaineer. That is, as a means by which the porterage difficulty could almost be done away with, to get over the intermediate hot, unhealthy valleys, and to shorten vastly the time, and to lessen the labour involved in getting to the base of operations.

It could transport the provisions, stores, and climbers to the base camp. It could take them back from there. It could bring up fresh provisions, mails, and news from the plains. It might even be employed to drop provisions, stores, and tents, on high, but accessible plateaus which might be discovered, and thus enormously shorten the time required, and lighten vastly the climbers' loads and tasks.

Camps and Bivouacs

In the Alps nowadays, as we saw in the Alpine Section, camping, and voluntary bivouacs have been

practically given up. They are still necessary in most of the other great ranges.

Low camps vary with the conditions, and their style and amount of comfort and luxury are largely a question of porterage and expense. I do not propose to deal with these at all, and would refer the inquirer to the hand-books on the subject.[1]

Except in the Himalayas, some of the central Asian ranges, and of course on Arctic and Antarctic heights, high camps on snow will not often be required. As a rule high camps are best pitched on the highest grass to be found. It will rarely be worth while to carry tents past this to pitch them on rocks. Though it has been stated, by a poet, however, that "rocks by custom turn to beds of down," I have not found this to be the case. Possibly I did not persevere long enough. It is astonishing how difficult it is to find in the mountains a level space large enough to hold even a small tent. If the ground is not level, or nearly so, it will pay to build it up with stones covered with turf, or to dig into the slope above, or both. If this is not done, great discomfort will be caused to the occupants during the night, by the slipperiness of the ground-sheet causing them to slide together, or outside. Care should be taken to select a site free from any danger of falling stones, ice-avalanches, or water. If there is any risk whatever from these sources then the shelter of a boulder or overhanging rock should be sought for.

The Mummery tent is a very convenient form for high altitudes. This works without poles or pegs; ice-axes form the poles, and the holding-down cords are fastened to heavy stones. If this form of tent is taken, it should be noted that the modern axe-shaft is too short to support the tent properly. The following arrangement answers perfectly. Two pieces of bamboo ten or twelve inches in length, of a diameter to fit over the spike of the axe and jam on the shaft, are carried.

[1] Galton's *Art of Travel; The Camper's Handbook*, by W. H. Holding.

Of course the axes are not stuck in the ground, but sit on their heads with the spike in the air. In the upper edges of the pieces of bamboo slits are cut, through which the supporting cords of the tent are passed, and secured to heavy stones. The longer the cords, the firmer the tent. No knot is really required, but in strong wind it is better to put on side-guys; these are best secured by clove-hitches. The "Improved Mummery," of waxed material, is very warm, as it is really a closed bag, with sewn-in ground-sheet, but there is no ventilation except at the door, and it is apt to be stuffy. I have used a very light tent of "A" pattern at heights up to 10,000 feet—moraine debris—in the Caucasus, and found it very convenient and comfortable. It has a separate rubber ground-sheet, pegs of aluminium, and bamboo fishing-rod poles, and the total inclusive weight is only six and a half pounds. It has double doors, and does not lack for ventilation. It stands well if carefully pegged, and the pegs secured by placing stones across the strings. This tent has successfully stood a blizzard of snow at 2,000 feet in Scotland, in February, with no less than three men inside. The dimensions are only 6 ft. 3 in. × 4 ft. 6 in. It should be noted that no light tent ought to be loaded so that the occupants touch the walls. If this happens the rain at once comes through, as the tent is used without a fly.

In choosing a site for either a tent or a bivouac on the heights, the first essentials are shelter from wind and proximity to water. Even a comparatively low wall of loose stones will keep off a great deal of wind. Before setting up the bag form of tent, or before laying the ground-sheet of the open kind, it will pay to go carefully over the ground and remove any prominent stones if possible. If not, then to fill up with as small stones or gravel as can be found. An astonishing increase in comfort will be obtained by finding out the exact spot where the hip-bone will come, hollowing out the stones, and lining the hollow with soft earth, grass,

or any spareable extras. If two men are to occupy one of these small tents this method is doubly good value, as it will tend to confine the restless comrade to his proper territory, and render the invasion and awakening of the peaceable less likely.

By far the most convenient and efficient and portable stove for the high camp is the "Primus"; the roarer form is best.

A wood fire is cheery and companionable, and, if ample porterage is available, can be made with wood brought up from the last dead trees. If juniper or rhododendrons are in the neighbourhood, these can be used, as they burn when green. A wood fire cannot be used inside the tent; a paraffin or alcohol stove can be. Care must, of course, be taken to see that the former is clean and working properly, else it may flare up and set fire to the tent. It is better that the tent used as a kitchen should have a loose ground-sheet. This can be folded back, and a place made for the stove on the ground. Spirit-stoves are light, convenient, and tolerably effective, but extravagant of fuel perhaps not easily replaced.

Before retiring for the night, water for the morning meal should be collected, placed inside the tent and covered up; but in a position where it will not be likely to be upset. At the usual height of a high camp or bivouac, the water supply will probably be dried up by frost during the night.

If ample porterage is available, a couple of thermos flasks carried up to the high camp would save fuel and time in the morning.

Forced Bivouacs

These will generally be made under bad conditions of the party, of the mountain, or perhaps of both. The first essential, when a forced bivouac appears probable, is to seek a site which affords the greatest amount of shelter from wind and from snow, or rain. It is better

not to delay fixing upon this too long. An endeavour should be made to leave enough daylight to arrange the site as comfortably as can be managed. The first care on settling down, especially with an exhausted, ill, or injured member, should be, to get on dry extras next the skin. Shetlands are far the best for this purpose. Dry gloves should also be put on and, if possible, socks also. The food should then be taken stock of, and served out, retaining a reserve for the morning. If the party carries an aluminium cooker, tea will be made from water or snow. This helps to pass the time wonderfully, even if only a small quantity can be made. Spirits, except for a small quantity perhaps in the tea, are much better reserved till just before the time of startimg in the morning. After the food comes the question of sleep. Some people, especially guides, can sleep under any circumstances. It is not likely that an amateur party, forced to spend the night out above snow-level, will be able to sleep much. They should sit, or lie, if the position allows it, closely huddled together, with the weakest in the centre.

Puttees, if worn, should be loosened ; crampons taken off, or their straps slackened.

Telling stories or singing songs has been recommended for the purpose of passing the time. Certainly the latter is good, especially songs possessing an easy chorus. No one will be inclined to criticise the singer, even if he has a voice which might be thought raucous in a drawing-room.

Though a night out on the snow-peaks rarely does anyone any harm, if reasonable precautions such as suggested are taken, still, especially if the weather is bad and rocks iced next morning, a considerable amount of unnecessary risk may be run, and anxiety to friends may be caused. Perhaps the benighted may enjoy the notoriety, and expense, of being rescued by a relief party of guides. It is really no credit to get benighted, though useful as an experience once. Those who make a practice of it, are proving that they habitually attack

climbs for which their mountain technique and experience are insufficient. That is, they are oromaniacal gamblers.

Mountain Lassitude

Mountain sickness was undoubtedly due to errors of training, or want of training, and of diet. It is not likely to trouble the average healthy mountaineer up to the height of Mont Blanc at any rate. Mountain lassitude is a different thing, and must most seriously be taken into account by those who would attack the highest summits of the globe.

Some of those who have dealt theoretically with the possibilities of high mountain ascents, have been most pessimistic with regard to the probability that man, by his own powers, will ever be able to set foot upon the highest points of earth's surface. For my own part, though I have carefully studied and taken into account all the cons as well as the pros of the subject, as presented in theory and practice, I never at any time have felt the smallest doubt of the ultimate conquest of Everest.

Mountain lassitude is an extremely complex question. It is often very difficult to disassociate its symptoms and effects from those caused by fatigue, pure and simple.

The most extensive scientific study of the subject was that carried out by Professor Angelo Mosso in 1886, at the Regina Margherita hut, near the summit of the Gnifeti peak of Monte Rosa, at the height of 4,560 metres, nearly 15,000 feet.

Professor Mosso was the author of another study,[1] that on fatigue, some years earlier. Besides his brother, Professor Ugo Mosso, and several other scientific assistants, he had ten soldiers of Italian Alpine regiments to study. The experiments went to prove that, when acclimatised, which usually took place in a few

[1] *La Fatica.*

days, little or no discomfort was experienced, and that in many cases, more and harder work could be done at 4,560 metres than in the Italian plains. The main trouble was a shortness of breath.[1]

Unfortunately for our purpose, the top of Monte Rosa is not high enough to permit us to gauge the possibilities at nearly double that height.

Mountain lassitude, or sickness as they call it, has been compared by some to the trouble experienced by aeronauts in high ascents. This, however, has little practical bearing on the subject; the conditions are utterly different.

Of even less value are experiments under the receiver of the air-pump. By taking certain precautions, and inhaling oxygen, a diminished pressure of atmosphere corresponding to nearly three times the height of Everest has been successfully endured by men.

In free air, aeronauts have reached, in balloons, about 34,000 feet, in aeroplanes about 30,000 feet. In all these cases the period of *time* at these low pressures was very short, and oxygen was inhaled. I do not consider, for reasons which will be given later, that oxygen inhalation will be of any use to mountaineers, who have to walk up to 29,000 feet on their own feet.

The task of raising the human body, by its own engine power, into such a tenuous atmosphere as exists at great heights, is an extremely hard one; it is complicated by many difficulties besides those due to want of oxygen.

The chief danger, in aeronautical ascents to great heights, results from the *sudden* diminution of atmospheric pressure. This disturbs the equilibrium of the

[1] In 1894 Professor Kronecker published a volume, *Bergkrankheit*, embodying experiments carried out by order of the Swiss Government before the Jungfrau Railway was authorised. The experiments were made on people from 10 to 70 years of age. Most were unaffected by *Bergkrankheit*. Dr. Swan, in a paper read to the Aeronautical Society in 1919, gave an account of many observations made on people who went up by this railway. Most were unaffected. ("Some Physical and Psychical Effects of Altitude," *Aeronautical Journal*, January, 1920.)

body and blood gases; asphyxiation, and stoppage of the blood circulation are induced.

The so-called "caisson disease," which caused the death of many workmen employed in under-water bridge and breakwater building, was the result of the too sudden reduction of atmospheric pressure on the men coming out of the compressed-air caissons in which they worked.

The mountaineer has no problems of this kind to solve; his pressure reduction does not take place in a few minutes, but extends over many hours, days, or even weeks.

Oxygen is used by aeronauts, and also by experimenters under air-pumps. Its use has often been proposed by planners of high ascents. I cannot make out that it has ever been employed seriously.[1] In any case up to now, in whatever form oxygen has been tried, no benefit whatever has resulted.

At 18,100 feet above sea-level the amount of oxygen in the air has already diminished to one half; there is, however, still plenty of it. Any troubles at that height are not due to want of oxygen. As the small boy said when his mother reproached him for eating too much pudding, "It's not too much pudding, mother; it's too little boy."

There is plenty of oxygen still left, even at 30,000 feet. Of course its diminution is at a geometrically decreasing rate, logically, even at 1,000,000 miles from the earth, it should still exist.

Our trouble at great heights is, that the heart is not big enough, or has not yet learned to beat fast enough, to secure the necessary amount from the air.

We may divide mountain lassitude effects into really two phases, according as we press the assault too quickly or delay too long over it.

The first is a more or less temporary one, partaking of the nature of asphyxia, due to fatigue of the heart, and is brought on by the diminution of oxygen, and the

[1] See A. L. Mumm, *Five Months in the Himalayas.*

heart's failure to increase its beats to compensate for this. Breathing is normally an involuntary action. Breathing at great heights, until the heart becomes acclimatised and learns the new rhythm, is not; it requires a more or less conscious exercise of the will. This is what explains the difficulty, often the impossibility, of sleeping at great heights: the higher powers of the brain have to be in charge, otherwise the heart stops work. When the heart learns the new rhythm, if it is capable of learning it, then sleep will be possible and normal.

As regards high ascents, they may for the present purpose be divided into three stages.

The first contains all ascents up to about the height of Mont Blanc, say 16,000 feet. As far as this the normal, healthy person, should find little or no trouble.[1]

The second may be taken at from 16,000 to 20,000 or 21,000 feet. Most mountaineers will find an increasing difficulty in climbing, and a stronger necessity of acclimatisation.

At the third stage, 21,000 feet and upwards, climbing will become so difficult that only the very fit, very determined, very lightly loaded and careful mountaineer will be able to make progress at all.

We may now consider the opinions and the practical experience of those concerned in the highest ascents hitherto made.

Very many travellers, and very many mountaineers, have described their feelings and sensations of mountain sickness, and many ways of combatting it have been proposed. One scientific (?) authority ascribed it to anæmia of the brain, and proposed to cure it by standing on the head. I have heard of a guide doing this, warbling loudly the while, on the very summit of the Jungfrau; but his employer did not consider that the guide was engaged in any scientific study. An abstainer himself, he declared the man "simply drunk." Per-

[1] Gold-mining is carried on at Thok Jalung, in Tibet (16,400). Sulphur is mined from the crater of Iztaccihuatl (17,000?) Mexico.

haps "somewhat elevated" would have been more literally correct.

The six highest ascents hitherto made are all in the region of the Himalayas and Karakoram Mountains. The lowest of these six is higher than any mountain summit on the other continents. The problem of further high climbing is therefore a purely Asiatic one. The following are these six expeditions.

The Duc D'Abruzzi and his three Italian guides, though they did not succeed in reaching the summit of his mountain, Bride Peak, in the Karakorams, yet hold, by fully 600 feet, the record height gained by mountaineers—24,600 feet—in July 1909.

The other five all lie between 23,183 and 24,000 feet. They were made by Messrs. Rubenson and Monraad Aas, Dr. Longstaff and his two Italian guides, Dr. W. H. Workman, Signor Mario Piacenza, and Dr. Kellas, with a number of native porters.

I must exclude Mr. W. W. Graham's plucky effort, the supposed ascent of Kabru in 1883, as I am convinced that the peak he *almost* attained was not Kabru (24,000 feet), but a lower peak of about 22,000 feet on the south-east ridge. Such at least is the conviction forced upon me by a careful study of his writings, of the latest maps and photographs, and of all the evidence given in the somewhat extensive controversial literature which sprang up around the subject of the expedition. Nevertheless, Graham's climb, with Boss and Kaufmann, remains as one of the greatest *tours de force* ever made in the history of mountain-climbing. He, however, gives us no information with regard to mountain lassitude, as he did not experience it. Leaving out Graham, all these highest parties were affected by mountain lassitude in more or less acute form: as were, indeed, expeditions which did not get within 3,000 feet of the Duc D'Abruzzi's record, such as Sir W. M. Conway's, Dr. Jacot Guillarmod's, and others.

There appears to be no general agreement with regard to the way in which this lassitude and weakness

should be combatted. Some have advocated "rushing" the peaks. This seems to be Dr. Longstaff's opinion. Others, like Dr. Kellas, who has had great experience of high ascents, have advocated gradual acclimatisation. The experience of the Eckenstein-Guillarmod Karakoram expedition of 1902, and also to a great extent that of the Duc D'Abruzzi and De Philippi in 1909, in the same region, would seem to rather confirm the opinion of Dr. Longstaff. These parties found that, by a prolonged stay at great heights, other symptoms began to appear, which in the end became more effective in preventing success than the disabilities first experienced. These were connected with the digestion of food.

Dr. Guillarmod put down his party's loss of appetite, of weight, and of strength, to the tinned foods on which they largely subsisted. No doubt he is partly right. De Philippi, though his party suffered in much the same way, does not blame the tinned meats. Both explorers describe the loathing all felt for the contents of the various cases.

The symptoms experienced by these parties point to a slow poisoning, owing to the non-elimination from the blood of the waste products of life. This is the secondary and more serious cause of mountain lassitude. The question of suitable food is therefore of very great importance.

A few years ago one of those silly crazes of the perpetual-motion type was very prominent in our ephemeral literature. This was the "doping" of athletes and horses with oxygen. By this means wonderful results were going to be obtained, equivalent to extracting a quart of liquid out of a pint pot.

Oxygen is certainly a strong stimulant, but for that very reason is wholly unsuitable for a prolonged effort, such as mountaineering. Here we must not expend our reserves quickly. We must, on the contrary, conserve them as carefully as possible. The only way in which, it seems, oxygen might be of value, is, if it

were possible to devise an apparatus of very *light* weight, which would atomise it, and deliver it to the lungs sufficiently diluted to restore the air's composition to nearly normal. The weight of such an apparatus would almost certainly be a far greater drawback than any benefit it might confer.

Alcohol is a combination of oxygen with carbon and hydrogen in certain proportions. It is, whatever may be the classification put upon it by some theorists, in practical effect a powerful stimulant. It is also, according to the latest investigations, to some extent, a food. It has, however, like oxygen, when pure, a toxic effect in any quantity but doses so small as to be of no value as food *per se*. It is thus wholly unsuitable for work at great heights. There are, nevertheless, many strong testimonials to the benefit derived from small quantities of cognac *after* work, with soup or tea, in the evening. Examples of this will be found in the accounts of the expeditions of Mr. Belmore Brown and Professor Parker on Denali (Mt. McKinley) 20,300 feet, Rubenson and Monraad Aas on Kabru, nearly 24,000 feet, Drs. Jacot Guillarmod and Wessely, nearly 22,000 feet on K2, Sir W. M. Conway nearly the same height in the same district, the Karakorams, Dr. W. H. Workman, and many others. The benefit is probably in the assistance to the digestion. We cannot, however, expect alcohol to take the place of solid foods for prolonged efforts like mountaineering.

Sugar is, chemically speaking, alcohol + carbonic acid gas. It is, however, a true food, though not a body builder by itself. In my opinion it will prove, along with fats, and a certain amount of starch food, the most suitable for use during high ascents.

Sugar is, of all foods, the quickest and easiest digested, with the *smallest possible quantity of waste products*.

As we know nothing—and this is acknowledged by all really scientific investigators, like Professor Mosso—of *how* the vital processes are carried on, we must be

guided largely by the practical effects of this process, such as digestion and production of energy.

As regards modern tinned meats, my own view is that these by themselves are in reality slow poisons; that the sterilising process to which they have to be subjected destroys something, be it a vitamine or not, which is essential to their proper assimilation. They are, to a large extent, stomach-cheaters, of the nature of the synthetic foods (?), of which we have heard so much lately.

Digestion and elimination of waste products are weakened on the heights. It is perfectly easy to prepare a list of foods containing the requisite number of "calories." It is not so easy to persuade the stomach that foods which it dislikes are good for it.

Machine-made dietetic rules will not work in high climbing. As Dr. Clifford Allbutt wrote in 1876: "A time of stress is not the time to annoy the stomach with strange foods."

In many cases the true way with rival theories lies *in medias res.* Probably the best way of combatting mountain lassitude, and of reaching the greatest altitudes, is by steering a way between the Scylla of overstrain of the heart by rushing the great peaks and the Charybdis of gradual poisoning by remaining long at high altitudes.

The best procedure seems probably this. A stay for acclimatisation at the highest elevation found not to produce discomfort; this will probably be about 15,000 to 16,000 feet, and training there, but not too severely; living as well and as comfortably as possible.

Then a rush at the last 12–13,000 feet in the course of five or six days, eating no meat, and not a great deal of other food, depending chiefly on sugar, dried prunes, or other fruits, dried milk, butter or margarine, and neglecting any loss of weight the while.

Victory would most probably go to the party best able to pull in their belts farthest, and yet work as

much as those forced to consume, and carry, heavy loads of food.

These high climbers should also be regarded as a storming-party. The mountaineering general who was bent upon the conquest of the highest peaks of the globe, would do well to reserve it as much as possible from the marching and carrying, the sapping and mining, necessary in preparing the attack.

The symptoms of mountain lassitude are difficult to describe. Most find that it has greatest effect upon the legs. These appear to weigh enormously. Lifting them and the body becomes gradually impossible.

The old symptoms of mountain sickness, such as bleeding at the nose and ears, vomiting, and severe headache, are now seldom met with in the real mountain lassitude. An apathy of the mind, a creeping paralysis of the limbs, seems the fairest description; no pain, but an utter weariness.

In severe cases only a few steps can be climbed without a pause; this is spent in gasping for breath, and waiting till the heart slows down a little. On sitting down the symptoms usually subside, and, on turning down-hill, generally completely disappear.

No after-effects of any kind seem to be felt. A return to a denser atmosphere is a cure complete and absolute.

My own experience in the matter has been very slight. On only one occasion, the ascent of Elbruz (about 18,400 feet), did I feel symptoms at all marked. Here, as is usually the case, it is difficult to separate the effects entirely from those of fatigue.

The party of three, Messrs. W. N. Ling, Rembert Martinson, and myself, made the ascent from the base, 6,000 feet, to the top, up and down, in 27 hours, without porters, tents, sleeping-bags, or sleep. The last 1,500 feet was felt very hard going by all. My own sensations were peculiarly like those felt in a vivid and annoying dream, when the lead-loaded limbs refuse to obey the brain's commands. One point of interest and encour-

agement may be noted. Contrary to what has been surmised, I found that the small amount of rock-climbing we met with, at about 17,500 to 18,000 feet, was *easier* than the monotonous trudge up snow and ice everywhere else. The hands here could take a considerable weight off the thigh muscles, naturally, of course, the most tired. On the summit the symptoms quickly subsided, and we found no difficulty in walking about and taking photographs. No symptoms of mountain lassitude were felt on the descent.

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Envoi

Why do we mountaineers love the Alps ? Is it their beauty and majesty of form which appeal to us ? Is it because of the pure physical enjoyment of the struggle with the difficulties, maybe with the dangers of the ascent ? or the mental exhilaration of setting one's wits to discover the safe way to overcome the icy or rocky barriers that guard access to the heights ?

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